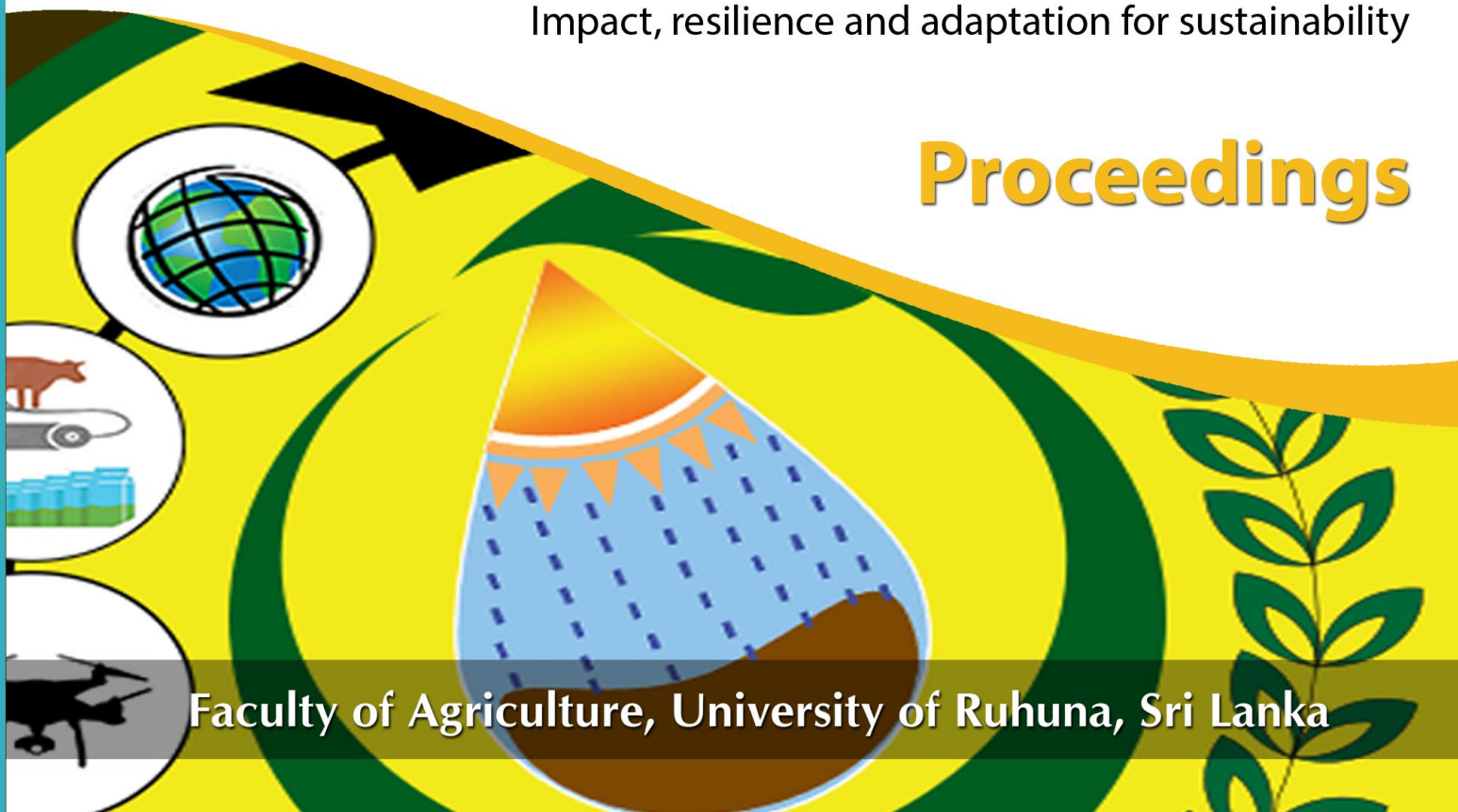
ISAE 2021

International Symposium on Agriculture & Environment

Challenges in Agriculture:
Impact, resilience and adaptation for sustainability

Proceedings



Faculty of Agriculture, University of Ruhuna, Sri Lanka

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"Challenges in Agriculture: Impact, resilience and adaptation for sustainability"

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Preface

It is with enormous pleasure and delight the Editorial Board unveils the Proceedings of the International Symposium on Agriculture and Environment (ISAE 2021). The ISAE 2021 International Symposium will be held on 7th May, 2021 as a virtual event due to ongoing COVID-19 pandemic. The theme of this year's symposium is "**Challenges in Agriculture: impact, resilience and adaptation for sustainability**" which is perfectly matching to the contemporary global interest of modern agriculture.

As of 2020, the world's farmers essentially produce adequate food to feed the world population, however, due to uneven distribution, unfair subsidy and trade practices, and deprived integration of supply chains, more than one billion of the planet's 7.7 billion people face food insecurity. Making the situation more intricate the World Health Organization declared COVID-19 a global pandemic on the 11th of March 2020 which adversely impacted on world's agricultural economy mainly on following aspects. The order of those aspects are the sequence of crop production, agricultural products supply, livestock production, farmers' income and employment, economic crop development, agricultural products sales model, leisure agriculture development, and agricultural products trade. As you all well aware, agricultural activities are by nature prone to numerous challenges and uncertainties, be they abiotic (such as water, light, radiation, temperature, humidity or soil), biotic (including pandemia, pests and diseases), or a result of prevailing cultural or economic conditions. In addition, in the present context high-input, resource-intensive farming systems, which have caused massive deforestation, water scarcities, soil depletion and high levels of greenhouse gas emissions, cannot deliver sustainable food and agricultural production. Needed are innovative systems that protect and enhance the agro-ecosystem resilience with natural resource base, while increasing productivity and recourse intensification. To ensure the agricultural resilience, it is very much obligatory to preserve a transformative process towards 'holistic' approaches, such as agro-ecology, agro-forestry, climate-smart agriculture and conservation agriculture, which also build upon indigenous and traditional knowledge. Technological improvements, along with drastic cuts in economy-wide and agricultural fossil fuel use, would help address climate change challenge and the intensification of natural hazards, which affect all ecosystems and every aspect of human life. Greater international collaboration is needed to prevent emerging trans-boundary agriculture and food system threats, such as pests and diseases like ongoing COVID-19 Pandemic. To adapt the sustainability, 2030 agenda for Sustainable Development embodies such a vision, one that goes beyond the divide of 'developed' and 'developing' countries. Sustainable development is a universal challenge and the collective responsibility for all countries, requiring fundamental changes in the way all societies produce and consume.

The Editorial Board postulates that the Proceedings of the ISAE 2021 contributes as a rich collection of knowledge compiled by renowned scientists, policymakers, planners, technologists, and thinkers on the main theme of ISAE 2021 "Challenges in Agriculture: impact, resilience and adaptation for sustainability". There will be 113. papers presented at 9 parallel technical sessions under seven Sub-themes namely 1) Challenges in Agriculture (main theme) 2) Plant, soil and Environment (3) Livestock, Poultry and Aquaculture (4) Innovative Technologies (5) Food and Nutrition (6) Agri Business and Entrepreneurship and (7) Crop Production Technologies. This proceeding is also enriched with the communications based on the keynote speech of the inaugural session by Professor David Rowlings, soil scientist, School of Biology & Environmental Science, Science and Engineering Faculty, Queensland University of Technology, Australia and 6 keynote speeches presented at the 7 technical sessions. On behalf of the Editorial Board and the Publication Committee, I would like to extend our deepest thankfulness to the chief guest, keynote speakers and all authors for their scholarly contribution and splendid collaboration in the process of compiling this proceeding. Proceedings of the ISAE 2021 are a substantial outcome of a much devoted team effort of many including the coordinator (Dr. Anuga Liyanage) of ISAE 2021 and, the members of the publication committee and the Editorial Board.

Their untiring effort is tremendously admired and acknowledged. On behalf of the Editorial Board, as the editor-in chief of ISAE for 4th consecutive time, I would like to extend my best wishes to all participants for a productive and satisfying experience in the ISAE 2021 virtual conference.

Stay safe.

Prof. Guttila Yugantha Jayasinghe
Editor-in-Chief
Proceedings-ISAE 2021

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Message from the Chief Guest

Hon. Minister Mahinda Amaraweera
Minister of Environment

It brings me utmost pleasure and pride to send this message on the occasion of 11th International symposium on Agriculture and Environment (2021) organized by the Faculty of Agriculture, University of Ruhuna on the theme of "Challenges in Agriculture: impact, resilient and adaptation for sustainability".

Attempts to develop the agriculture sector while protecting the environment should be considered as the main challenge for sustainable agricultural operations. In the process of agricultural development, it seems to be a huge threat to the environmental sustainability. Therefore, a sound adaptations and resilience are vital to address future challenges in agriculture through sustainable approaches. Moving towards especially during this challenging era with inclement climatic conditions, global warming and spreading of pandemic diseases like Covid-19, agriculture sector should be strengthen to ensure food security and produce healthy and safer food for the increasing human population.

The theme of the symposium of this year is a timely intervention and vital for providing an ideal scientific platform to share the knowledge and experience of sustainable strengths of agriculture to combat challenges in Agriculture and Environment.

I am extremely glad that the Faculty of Agriculture has given a high priority for research extension initiatives. I appreciate very much for their continuous efforts to share their new knowledge and experience with numerous scientists and intellectuals from many different countries through organizing ISAE symposia annually. Considering the prevailing Covid 19 pandemic situation, I appreciate the organizing committee of ISAE 2021 for arranging this year symposium as a virtual conference which is the best option at this juncture. While wishing the conference every success, finally I congratulate to all the presenters, the symposium organizers, participants and all the contributors to make ISAE 2021 a reality under the flag of University of Ruhuna.

Message from the Vice Chancellor
University of Ruhuna

As the Vice Chancellor of University of Ruhuna, it gives me immense pleasure to send this message to the International Symposium on Agriculture and Environment (ISAE 2021). This is one of the most prominent scientific conferences of the University of Ruhuna. The theme of the ISAE2021 is "*Challenges in Agriculture: impact, resilience and adaptation for sustainability*".

Agriculture plays a vital role in the socio-economic context of Sri Lanka. In addition to providing food and raw material, agriculture is one of the prominent livelihood approaches in the country. However, the agricultural sector is facing a wide range of ecological and economic challenges.

Demand for food and other agricultural products is projected to increase by 50% between 2012 to 2050. In addition, structural changes in the demand for food and agricultural products could be experienced with the rapid population growth, urbanization and per capita increases in income. However, fulfilling the increasing and changing demand with limited natural resources is a complex challenge. Hence, agricultural productivity should be sustainably improved to overcome those challenges.

On the other hand, agricultural sector has to deal with severe environmental issues including, water scarcity and pollution, soil deterioration, biodiversity degradation, as well as high emissions of greenhouse gases responsible for climate change. It is essential to address climate change and the intensification of natural hazards to minimize unexpected yield losses and income fluctuations. Furthermore, sustainable agricultural practices should be adopted to mitigate ecological issues. Economically viable, environmentally friendly and socially justifiable agricultural production systems should be promoted to address all these issues.

ISAE 2021 would encourage an interactive discussion and create a multidisciplinary platform to share insights in the selected thematic area. ISAE 2021 provides an excellent scholarly forum for academics, researchers, students and industry personnel to share the scientific knowledge and research findings in the field of agriculture.

At this time, ISAE 2021 has been organized as a virtual symposium. I profoundly appreciate the enormous effort of the Dean, Faculty of Agriculture, Coordinator of the ISAE 2021 and the organizing committee in organizing such a premier scientific conference while overcoming the challenges of the COVID 19 pandemic.

I wholeheartedly wish the International Symposium on Agriculture and Environment 2021 a great success.

I look forward to witness a fruitful conference.

Snr. Prof. Sujeewa Amarasena
Vice Chancellor
University of Ruhuna

Message from the Dean
Faculty of Agriculture, University of Ruhuna

It is a great pleasure and honor to send this message as the Dean on behalf of my colleagues who worked tirelessly to organize this symposium amidst many obstacles and challenges with the prevailing COVID-19 pandemic situation in the country. The Faculty of Agriculture, University of Ruhuna has very successfully organized two national and ten international symposia during the past and the first edition of ISAE was hosted ten years ago. We are committed to raise the standard of this event and live up to the expectations of researchers who selected our symposium to present their research findings.

Our vision is to make ISAE an annual meeting place for scientists and professionals in agricultural, environmental and allied sciences to share their research findings, innovative ideas and forge new collaborations. Agriculture is considered as one of the main polluters of environment and our biggest challenge is to raise the agricultural production to feed the ever increasing human population while protecting the environment.

The broad theme of this year's symposium is *"Challenges in Agriculture: impact, resilience and adaptation for sustainability"*; highlighting the need of new strategies for agricultural and environmental management for enhanced productivity and to ensure prudent use of biological and natural resources to sustain a healthy population on planet earth. Modern agriculture fulfils multiple roles and purposes, including producing more food for a growing population, supplying raw materials for expanding industrial and bioenergy sectors, conserving the natural resources, environment and biodiversity. In Sri Lanka, agriculture contributes significantly in providing rural employment, livelihoods and economic development. It is evident that the present crisis with COVID-19 pandemic has pushed many people towards agriculture and agro-based industries. The global demand for food is projected to increase several folds in the coming decades and there will be greater consumption of processed foods, animal proteins, fruits and vegetables with higher demand for food quality and safety. At the same time, there will be increasing efforts to address some of the negative impacts on environment caused by agriculture. Our country is in need of a solid approach in natural resource management to position Sri Lanka's agriculture sector towards effective and efficient fulfillment of its multi-functional roles.

Networking in research is pivotal for the advancement of science and technology and hopefully, the presentations done and discussions followed at this symposium would lead to further research and development of technologies and collaborations towards national development. I take this opportunity to express my sincere gratitude to all my colleagues of the organizing committee who devoted their time and energy to make this event a success. Finally, I sincerely wish all authors, invited speakers, special guests and participants a productive and pleasant virtual stay at the ISAE 2021.

Snr. Prof. Sudas D. Wanniarachchi
Dean, Faculty of Agriculture
University of Ruhuna

Message from the Coordinator of the Symposium

It brings me utmost pleasure to convey my warm wishes to all participants of the 11th International Symposium on Agriculture and Environment (ISAE- 2021). This year symposium is organized under the theme of "Challenges in Agriculture; Impact Resilience and Adaptation for Sustainability" which crate a platform for scientists, policy makers and other interested communities to express their views and ideas and share knowledge and experience with the aim of finding solutions for the challenges in agriculture and environment sectors. The theme is timely important to the prevailing global situation as the whole globe is fighting with the Covid-19 pandemic.

Agriculture, not only contributes to global food production but also affects the living environment by threatening, transforming whole production and livelihood. Increasing agricultural production under drastically changing climate is a profound challenge to be addressed immediately to ensure safer food production for rapidly increasing global population. To overcome the challenges in future agriculture and environment context, there is a urgent need to focus on nature based holistic approaches.

This type of international symposia in the joined framework with the gathering of many national and international communities will influence the understanding and sharing research experiences related to solving problems in agriculture and environment sectors to a greater extent.

We expect that this scientific forum will open intellectual minds of development of international integration of intellect in minimizing the issues of agriculture and environmental sectors while creating an educational and scientific base. I wish to extend my gratitude to the academic and non-academic staff, students of the Faculty of Agriculture, University of Ruhuna who played an important role behind the seen to make this event a reality. I genuinely hope that you would use the ISAE 2021 as an interesting and educational meeting. I wish all the participants every success in their future endeavors.

Dr. Anuga Liyanage
Coordinator, ISAE 2021

Keynote Speech of the Inaugural Session

Challenges in Agriculture: impact, resilience and adaptation for sustainability

Prof. David Rowlings
Soil Scientist, School of Biology & Environmental Science, Science and Engineering Faculty, Queensland University of Technology Australia

There is a great article by Charles C Mann published in March 2018 issue of *The Atlantic* magazine titled "Can planet earth feed 10 billion people? Humanity has 30 years to find out". In it he describes how today global population of 7.6 billion inhabitants is projected to reach 10 billion by 2050 before leveling off. At the same time economists say the worlds development should continueand by the time my daughter is my age a sizable percentage of the world's population will be middle class. If this is the case we cannot keep using resources at a rate we have over the previous century. As a race we are nearing the safe "planetary boundary" for land-use, ocean acidification and the phosphorus cycle, and exceeded it for climate change, the nitrogen cycle and biodiversity loss by over 10 times for the later(Rockström *et al.*, 2009).

Mann argues the scientists tasked with solving these issues fall into two broad categories Wizards, exemplified by Normal Borlaug, father of the green revolution, and profits, represented by Willian Vogt, creator of the "apocalyptic environmentalism" concept.

Norman Borlaug has become the emblem of "techno-optimism", the view that science and technology, properly applied, will let us produce a way out of our predicament. He was the best-known figure in the research that in the 1960s created the Green Revolution, the combination of high-yielding crop varieties and agronomic techniques that increased grain harvests around the world, helping to avert tens of millions of deaths from hunger. To Borlaug, affluence was not the problem but the solution.

William Vogt born in 1902, had the belief that unless humankind drastically reduces consumption and limits population, it will ravage global ecosystems. High-intensity, Borlaug-style industrial farming, Prophets say, may pay off in the short run, but in the long run will make the day of ecological reckoning hit harder. The ruination of soil and water by heedless overuse will lead to environmental collapse, which will in turn create worldwide social convulsion.

In a time of increasing global inequality, plateauing yields, rapidsoil erosion, lab grown meats and most importantly climate change it is imperative wizards and profits must work together. We need science that improves crop varieties and farming systems for improved yield and climate tolerance, without increasing environmental impacts. Most importantly we need to factor the environmental costs into our food production, to ensure the true costs of sustainable agriculture are accounted for.

In this keynote we will highlight the dual challenges of plateauing agricultural production and environmental sustainability, and the huge challenges that agricultural and environmental scientists have to overcome these issues in an increasingly volatile climate.

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PAPER INDEX

PLANT, SOIL AND ENVIRONMENT

Poster Presentations

Challenges in Agriculture

Oral Presentations

Prospectus and challenges in Ceylon cinnamon exportation

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Abstract

Cinnamon is an important spice that is used worldwide. It is known as the king of the spices. Sri Lanka is well reputed for cinnamon exportation from king's days to present with 85% share of the international market. However, low qualities of the products bring many issues in the cinnamon export industry. Therefore, it is worthwhile to explore the prospectus and challenges of the ceylon cinnamon exportation, particularly among small and medium scale exporters. Small and medium scale cinnamon exporters were selected using a simple random sampling technique following the sampling frame obtained from the export development board. A mixed method approach was adopted to collect primary data through a questionnaire survey (n=20) and key informant interviews (n=5). Data analysis was confined to descriptive statistics, SWOT analysis and Wilcoxon Signed Rank test due to lesser number of cinnamon exporters in the country (μ =41; n =20). Low Coumarin levels compared to Cassia varieties bringing higher demand and acceptability at the international market has been perceived as a strength (66.7%) for ceylon cinnamon. Moreover, majority of the sample (60.7%) is optimistic on the international market. Despite 40% of the exporters expect product modifications, innovations, and product development. Yet, 60% respondendents did not have any clear idea on these aspects. This has been iterated as a challenge in gaining the competitive advantage. Furthermore, competitiveness in the cinnamon exporting industry has been hampered mainly by economic (W=3.855, P<.001), legal (W=2.038, P=0.042) and technological (W =4.057, P<.001) obstacles. Lack of advanced infrastructure facilities (W=2.798, P=.005), imperfect information on overseas market (W=2.613, P=.009) are illustrated as significant weaknesses. Moreover, the blending of pure ceylon cinnamon with imported impedes the brand image of the ceylon cinnamon (W=2.070, P=.038), appears to be a significant threat in future. Product quality development, improvement, and certification were suggested by 98% of the exporters to meet the global demand while marching with modern technology and innovations.

Keywords: Ceylon Cinnamon, Challenges, Exporters, Prospects, SWOT

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A case study of comparing the performance of turmeric (*Curcuma Longa* L.*):* Export during the transition period of Covid-19

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Abstract

The Agribusiness Entrepreneurship sector has been prolonged as a major source of livelihood for many agro-based communities in Sri Lanka. Turmeric (Curcuma longa L.) is predominately cultivated in Kurunegala, Kandy, Matale, Gampaha, Colombo, Kegalle, Kalutara, Galle, Matara, Badulla, Rathnapura, Polonnaruwa and in the Dry zone under the irrigated conditions. The study adapts resource based reviews in the combination of the statistical reports. The scope of this study is based on the past experiences of the selected three categories of commercial Turmeric cultivators in Sri Lanka. Furthermore, the current management practices of the Turmeric (Curcuma longa L.) were analyzed by focusing on three experiences of local commercial based cultivations by the recommendations given by the Department of Agriculture with the collaboration of the Export Agriculture Department. Selection criteria of the sample were based on the Random Sampling method. Based on the collective actions of Entrepreneurial identity, export relationship building and performance, scale of cultivation and quantity of exporting, quality management leading Good Manufacturing practices on the selected three export categories. The objectives of the study focus on 1.) To analyze the growing demand this is exceeding the self-sufficiency after the Covid-19 period. 2.)To identify the growing demand due to the restrictions of the Turmeric import. 3.)To investigate the quality wise management and the application of the Good Agricultural Practices which impact over the growing export demand for Turmeric. An explanatory analysis is conducted based on a case study. The retail price of Turmeric powder was Rs. 2900.00 in end of December 2019. It is the five times of rough value of the conventional price of Turmeric powder. Due to the import ban a shortage of turmeric in the local market and price reached in high of Rs. 4,500.00 for kilo gram by the end of September. The export production was reduced 0.456% due to the increasing of self-sufficiency. The research clearly 1identifies the how the transition take place with the Turmeric in relevant to the scale of cultivation and quantity of exporting, quality management leading Good Manufacturing practices and Good Agricultural Practices are analyzed.

Keywords: Covid-19, Export, Good Agricultural practices, Turmeric

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Analysis of extreme climate events during 1981 - 2019 across Sri Lanka

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Abstract

Climate change is considered as a global issue with long term inevitable changes in climate. Many parts of Sri Lanka are vulnerable to extreme climatic events. Therefore, this study focuses on the occurrence of extreme temperature and rainfall events in seven selected locations (Mahailuppallama, Hambantota, Batalagoda, Monaragala, Nuwaraeliya, Galle, Katugastota) representing the major Agro-ecological zones of Sri Lanka from 1981 to 2019. Five extreme temperature and precipitation indices were selected based on definitions for extreme climate events by the xxpert team on climate change detection and indices which is jointly established by world metrological organization and the world climate research program. Data quality control was done by using the RClimDex software (version 4.0.2). Extreme climate indices were calculated by RClimDex software package and annual trends of extreme climatic events were analyzed by regression and Mann Kendal tests. Significant positive trends ($p<0.05$) were observed for warm nights in all the selected locations except Batalagoda which showed a significant negative trend. Hambantota and Katugastota showed a significant positive trend for warm days in many months. A significant decreasing trend of the monthly mean difference between the maximum and minimum temperature was observed at Monaragala. The monthly maximum of daily maximum temperature shows significant positive trends at Hambantota, Galle, and Katugastota. Both positive and negative trends were detected for extremely wet days. Accordingly, Hambantota (September) and Galle (October) showed positive trends whereas Galle (October) and Nuwaraeliya (September) showed negative trends. Very wet day precipitation showed a significant negative trend in Hambantota. Moneragala showed a significant positive trend only in April for very heavy precipitation days while Hambantota and Nuwaraeliya (June) and Batalagoda and Katugastota (July) showed significant negative trends. In contrast to other locations, no precipitation parameter was shown any significant change during the study period at Mahailuppallama. In conclusion, Temperature indices reflectingwarming trends at Batalagoda, Katugasthota, Hambanthota, Galle, Monaragala, and Nuwaraeliya. However, trends of precipitation indices were highly varied in terms of location and months.

Keywords: Climate indices, Extreme events, Mann Kendal, RClimDex

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Evaluation of farmer broadcasting service as a tool for disseminating agricultural information

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Abstract

Communication channels play pivotal role in disseminating information. But when the bulk of population is illiterate and inaccessible to modern means of communication, the challenge is all the more difficult. In this situation mass media like radio can play a significant role in disseminating information. Radio is a very popular and powerful communication medium and has proved very effective in helping to disseminate agricultural information. Farmer broadcasting service of the department of agriculture undertakes production and broadcasting of agricultural radio programmes to disseminate agriculture information to farm community in order to improve their knowledge and change attitudes in a favourable manner. A quasi-experimental study was designed to determine the present situation of farmer broadcasting service, the effectiveness and relevance of the programs on agricultural production and the factors which affect the production of farmer broadcasting service. A total of 146 farmers were selected randomly from Galle district. Data were collected using pre-tested questionnaires. The findings of the study show that the majority of the respondents (99.32%) are radio listeners. Though there are various mass media communications, farmer broadcasting service is still used by farmers (82%). Information provided through farm broadcasting service programs has been reliable for 61% of farmers. Majority (70.5%) of the farmers were of the view that they prefer to listen agricultural news, 62% of the farmers expressed that they listen to discussion programs by an expert or an extension officer. However, 60% of farmers would like to listen the programmes in morning hours and evening hours. The first rank was given to agriculture instructors as the most credible source of information regarding agriculture. Farmers have ranked the farmer broadcasting service next to the television. The majority (71.92%) of the farmers in Galle district are engage in the rice cultivation. Rice cultivators also engage in the vegetables, fruits and animal husbandry. All of the respondents (100%) are radio listeners and they are all (100%) know about the farmer broadcasting service, but only 17.14% respondents have clearly listened. Among the eight programs the first rank was given to *Kadamalla* as the most famous program of farmer broadcasting service.

Keywords: Agricultural information, Disseminate, Farmer Broadcasting Service, Radio

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Managing disruptions of COVID-19 on agricultural supply chains

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Abstract
In addition to public health of people, the COVID-19 pandemic which was undertaken from the beginning of the year 2020 has caused major impacts on different economic sectors in Sri Lanka as well as in other countries. It is no exception to the Agriculture sector. Agricultural supply chains are instrumental in bringing farm produce to the market places. Farmers scattered across the country and logistic suppliers facilitate bringing the fresh and processed produced to the market place where multifunctional wholesalers and retailers cater the needs of variety of customers. COVID-19 pandemic has affected the livelihood of people all across the globe in different ways. Especially, food supplies were disturbed due to lockdown, restricted movements, curfew and other health regulations. Farmers were seriously affected with the disconnected supply chains in one hand. On the other hand, consumers based on cities and urban areas were unable to link into the market and food supplies. Income generation of the farmers was decline sharply pushing them towards to more vulnerable groups of the society. Consumption patterns were changed and depend on what is available locally. Food and nutritional security of both beginning and ending nodes of supply chain affected badly and created huge social issue. Therefore, modifications into the supply chain model develop strategic interventions to manage smooth supply chains and transformation of existing supply chain structure was recognized as an important issue to intervene in all levels. Current, study aimed to identify strategic interventions of agricultural supply chains to manage the impact of COVID-19 pandemic. Special attention has paid to identify the stepping up of digital solution providers to fill the voids caused by the pandemic and improvement of smart supply chains and positive and negative impacts of the digitalization of agricultural markets.

Keywords: Agricultural supply chains, COVID-19 pandemic, Transformation

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Future prospects of ecotourism in Kankesanthurai beach in Jaffna

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Abstract

Ecotourism is an emerging concept which creates a huge impact on people about conserving the environment and local culture while undertaking tourism. Hence, this study was conducted to examine the perception of tourists and the local community towards ecotourism and to analyze the future potential for ecotourism activities in Kankesanthurai beach. The study was carried out by a pre-tested questionnaire survey with 60 tourists and 60 local people selected by convenient and cluster sampling methods respectively. Data were analyzed using descriptive statistics and Wilcoxon signed-rank test. The study has shown that the majority of the tourists (78.4%) have a positive perception towards ecotourism. Further, results revealed that the locals' awareness level of ecotourism principles was significant ($p=0.000$) that comprises awareness in creating jobs ($M=1.60$), supporting local business and services ($M=1.18$), increasing demand for local cultural activities & amenities ($M=1.13$), attracting investment into the area ($M=1.03$) and providing natural and environmental protection ($M=1.00$) through eco-tourism. The study implied that the local community agreed that conventional tourism caused negative impacts such as poor sanitation, ıntrusion of outsiders, loss of native customs, damage to the natural flora and fauna and depletion of natural resources ($p<0.05$). In terms of the future potential for ecotourism activities, tourists significantly agreed that Kankesanthurai beach is an eco-friendly place and they agreed to pay a little more money for an eco-friendlier stay ($p=0.000$). Moreover, 75% of the tourists were willing to revisit the site and 87% of them were recommending the site to others. Both tourists and locals preferred cultural food festivals, local homestay of tourists, local area picnics, local indigenous product exhibitions, beach games clubs and underwater fish watching ($p<0.05$) as the potential future ecotourism activities. Further, locals were anticipating government support to enhance community cohesion, entrepreneurship skills, security and market facilities ($p<0.05$). This study concluded that there is a good potential to introduce ecotourism in Kankesanthurai beach. Therefore, rules and regulations should be strictly defined to eliminate the negative impact and establish Kankesanthurai beach as a more eco-friendlier place for everyone.

Keywords: Community perception, Ecotourism, Future prospects, Tourists perception

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Meta-analysis of Technical Efficiency (TE) in selected agricultural sub-sectors: implications for policy making to the government

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Abstract

Technical efficiency (TE) can be defined as the ability of a decision-making unit to produce maximum output with a given set of inputs and technology. In recent years, evaluating farmer's efficiency in an agricultural community has become a vital issue. To reduce the poverty of farmers, production efficiency needs to be optimized and the government-controlled policy interventions are necessary. Objective of this study was to evaluate the TE in selected agricultural sub-sectors and to propose possible policy interventions to the government. Study was conducted through a meta-analysis based on empirical studies conducted by various scientists worldwide. Research articles for the meta-analysis were selected using a thorough screening process based on the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) concept. Mean TE of each sub sector was calculated by averaging the TE values from different studies in the selected articles. TE data presented in the original articles show a considerable dispersion within a given study, in some cases dispersed in the range from 0.2 (min) to 0.9 (max). Of the 94 studies considered, only 47 studies have recorded a TE of above 0.8, where livestock sector stands out predominantly (poultry, dairy an aquaculture). Among the major crops belong to this category, cucumber and B-onion dominate. The highest mean TE was recorded in B-onion (0.83±0.15) whereas the lowest was recorded in maize (0.703±0.09) and in soybean (0.705±0.13). The TE of chili cultivation was 0.78 with the greatest variability (0.19 SEM) among the crops considered, which signifies the unpredictable nature of the chili cultivation. Dairy, poultry and aquaculture farming operations were found to be highly technically efficient having mean TE values of 0.80±0.16, 0.89±0.02 and 0.88±0.08, respectively. The broad differences in the technical efficiencies show that there is a need to make farmers aware to operate the farming techniques appropriately. Findings of this study will lead to several key policy implications including, improvement of the socioeconomic characteristics of farmers, implementation of farmer field schools (FFS) and establishment of a cautious and gradual strategy for expansion of the rural financial institutions in the farming communities in Sri Lanka.

Keywords: Agricultural technical efficiency (TE), Meta-analysis, Policy implications

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Factors affecting technology adoption in smallholder rubber sector: A case study in Kurunegala district

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Abstract

Adoption of recommendations is a critically important factor for the rubber cultivation as there is a high gap between the actual yield and potential yield of the recommend clones. Therefore, this study attempted to identify the factors affecting technology adoption in rubber smallholder sector in the Kurunegala district. A pre-tested semi-structured questionnaire survey was conducted for data collection. Sampling was done using a two-stage sampling technique with a sample of 112 farmers. In the first stage Rubber Development Officers (RDO) divisions were selected while rubber smallholders were selected in the second stage from selected RDO divisions. Heterogeneity, margin of error, confidence interval and non-respondent rates were respectively 50-50, 0.1, 95% and 10%. Data on demographic details, crop details, social relationships, income and adoption details were collected through the survey. A Fractional probit regression estimated the correct data generation process. Estimation was carried out in a Bayesian framework. Random Walk Metropolis Hasting algorithm was used to draw 300,000 samples. Out of which 250,000 was used as the analysis sample as 50,000 were discarded as a burn-in to reduce the impact of starting values. Markov Chain Monte Carlo convergence was checked using a visual diagnosis of trace plots, histograms and autocorrelation plots. Membership of a rubber related society, attending training programmes, and land extent show a positive relationship with adoption. Results also show that farmers with high incomes are technology adopters compared to low income farmers. According to the results, establishing and functioning rubber related societies as well as organizing training programmes are important to improve the technology adoption in the smallholder rubber sector.

Keywords: Adoption of technology, Bayesian analysis, Rubber, Smallholder

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Poster Presentations

Farmer's health and safety awareness on the use of agrochemicals by contract farmers: A case study in Anuradhapura

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Abstract

Majority of the farmers especially in the developing nations continue to be poisoned or killed owing to unsafe usage of agrochemicals. There is a primary concern of every government and international organization on safety and health in the usage of agrochemicals. The focus of this study was to determine the contract farmers' health and safety awareness on the application of agrochemicals. For this case study, one hundred contract farmers growing vegetables in Anuradhapura district were randomly selected. Primary data were collected through structured questionnaire and interview methods. Secondary data were collected from published scientific articles and conference papers. Descriptive analytical methods using SPSS version 16 statistical software were followed to analyze the data. The results revealed that only 10% of contract farmers always follow the instructions on the label of agrochemical bottles. Very fewer farmers (20%) always shower immediately after the end of the agrochemical application. Twelve percent of those surveyed in this study keep a record of the chemicals they use to grow vegetables. Only 10% of farmers keep the knapsack for re-use. Most of the farmers (72%) have some understanding about the hazards and risks of using chemicals in the field and 28% of farmers are less aware regarding the hazards and risks of chemicals in the field. 38% of the sample follows safety practices while others follow their own ways to control the hazards and risks in the field. Most farmers (68%) forget the safety instructions when they burdened with work. A higher percentage (75%) of farmers' believe that the life risk of using agrochemicals while working in the fields is serious and not life threating. According to the results farmers did not have an adequate knowledge and favorable attitudes towards health and safety risks in agriculture. Most of the farmers do not practice health and safety practices in the field.

Keywords: Agrochemicals**,** Contract farmers, Health and safety

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A Sociological study of the factors pushing the youth community out of Sri Lankan agriculture (Deniyaya area in Matara district with Lankagama village)

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Abstract
The agricultural sector occupies an important place in the economy. At present the labour force contribution in the agricultural sector is 26%. The problem of the study is what are the push factors that are driving the rural youth community away from agriculture. The main objective of the study was to identify the factors pushing the youth community away from agriculture (chena farming and tea cultivation) and analyse them from a sociological point of view. In-depeth interviews and observations were used in the collection of preliminary data for research data collection. Department of Census and Statistics records, Agriculture Officer and Grama Niladhari annual reports were used in the collection of secondary data. Random samples were selected from Lankagama with a sample size of 45 people which includes Grama Niladari, Agriculture Officers and people at various age levels. Qualitative methodology was used as the main methodology in this study. The livelihood of the villagers could be identified as chena farming and Kithul industry associated with the Sinharaja reserve. But today tea cultivation can be identified as the main livelihood due to the lack of permission to cultivate in the reserve and the impact of the open economy. At present, the interest of the young community in the plantation industry tea cultivation is very low. In this way, the problem of income and marketing can be identified as the main reason for young community to leave agriculture. It appears that a good price could not be obtained for tea cultivation due to the dilapidated condition of the Lankagama road system. Lankagama many lands do not have deeds and therefore it is not possible to obtain a bank loan when obtaining fertilizer machinery for cultivation. As a result, low-income tea buyers are being held hostage to" *Dalu potha*" (Daily Report Book) loans and high-interest loans, a unique feature of the village. Also, due to lack of infrastructure development, lack of technology and services and for education and employment goals, the young community left agriculture and migrated from village to town. Close proximity to the Sinharaja Reserve can be seen as a growth of the tourism industry in Lankagama village. It is also observed that the youth are leaving agriculture. The inability to identify a clear economic benefit in agriculture and plantation and the backwardness of the youth community in defining agriculture as a non-permanent economic activity is the main factor influencing the youth community to shift from agriculture and tea cultivation to other economic activities.

Keywords: Agriculture, Chena farming, Migration, Tea cultivation, Youth community

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Problems faced by Sri Lankan tea smallholders: A case study in Malwala GN division in Ratnapura district

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Abstract

The tea small-holding sector leads the industry by contributing 73% of the total tea production in Sri Lanka. Tea is one of the main sources of foreign exchange of Sri Lanka. From the global tea demand, Sri Lanka contributes 23%. Sri Lankan tea industry mainly divided into two parts as Plantation and tea small-holding sector. Hence one of the objectives of this study was to identify the problems faced by tea smallholders in Sri Lanka. The Tea Small Holding Development Authority has recorded that the tea small holding sub sector is being undermined by several factors. The most damaging problem is aging tea bushes. It will result to declining yield and low productivity. The annual replanting rate is 2%. The low replanting is a reason to environmental hazard also. Inadequate extension and training programs, climate change and inadequate credit problems are others problems which tea Small Holders facing. Since the above issues of tea smallholders directly effect on productivity and finally it will effect for the low income and low stand of living. The study was conducted in Malwala GN division of Ratnapura DS division with one hundred farmers selected from a random sampling method. Primary data was collected through a pre-tested questionnaire. Problems of tea smallholders were measured on 10 point scale. Respondents were asked to allocate 10 marks for the highly affected problem and 1 mark for the least affected problem. Data were analyzed by using descriptive statistical methods. According to the sample they have problems on lack of skilled laborers (78%), lack of extension services (65%), and lack of credit facilities (63%). The market fluctuations, pest and disease problems and especially transport problems are not major issues in this sample. Many of the farmers (85%) make planting materials for their own needs. Some farmers (44%) sell planting materials as an income source. In Ratnapura district adverse effect of climate on tea sector is not a significant problem. Government and all relevant authorities have to generate new policies to overcome lack of skilled labor, lack of extension facilities and lack of credit facilities issues.

Keywords: Credit facilities, Skilled labor, Sri Lankan tea industry, Tea small holders

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Opportunities for urban farming: The case study of Paranthan town in Killinochchi, Sri Lanka

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Abstract
In the middle of the economic crisis, the management of urban farming represents a key challenge for improving ecological performances within the city. Indeed, agricultural areas have a great potential in terms of urban re-generation, fostering a city's resilience and its energy efficiency, even in the perspective of climate change hazards. Further agricultural areas are also crucial for social opportunities and new job creation in the perspective of integrating both ecological and urban services in the framework of more competitive (and attractive) cities. According to the Millennium Ecosystem Assessment (MEA) definition of ecosystem services as constituents of well-being (MEA, 2005), this paper presents a case study that addresses urban agricultural areas can be act as an ecological infrastructure for the city. The study is structured as a research case study and focuses on a former agricultural area in the city center of Paranthan, Killinochchi. This is an almost agricultural area being an important city's landmark. Despite the abandonment of crops, the agricultural land use is still typical of the area and it represents a core potential to provide ecological and urban services for the city. The study discusses a demonstration project aimed at assessing comprehensive viability for managing agricultural use in order to protect the natural soils and updating both urban and ecological services (such as waste management, social security, sliding risk reduction) through a non-conventional public service policy. The results of this research reveal comprehensive viability of the urban farming by implementing integrated model for urban design for Paranthan Town, Kilinochchi that takes together the instance of upgrading ecological performances in the city with the need of create new jobs and economic opportunity.

Keywords: Agricultural area, Comprehensive viability, Ecosystem services, Urban farming, Urban re-generation

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Plant, Soil and Environment

Keynote Speech

Artificial macropores installation to restore organic matter in soils

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Abstract
Soil is the largest terrestrial carbon storage; it contains carbon as much as three times of plant biomass and two times of the atmosphere. Surface layer is the most fertile zone which is rich in organic matter. However, this fertile zone is degraded from rough land management, and also removed by heavy rain, which is considered as the effect of climate change. The typical characteristics of these degraded soils are poor in infiltration. Lack of organic matter fails to create soil aggregates and surface crust tends to be formed at the surface soils. Traditional countermeasure for this situation in cultivation is soil turn over. It makes soil layer softer, agricultural jobs easier and enhances infiltration. However, it may also break soil aggregates and make soils drier, which would be a cause of erosion and loss of organic matter. X-ray CT images of the natural soils showed that root created macropores were predominant. The tubular pore networks helps water and solute movement. Therefore, artificial macropores were installed in degraded red-yellow soils to enhance vertical infiltration without cultivation. Fibrous materials were inserted in the macropores to reinforce its structure while enhancing infiltration with their capillary force. Macropores and control (no macropore) plots were established and bulk density, hydraulic conductivity, plant biomass and total carbon in soil were measured. The results after one-year macropores installation were that bulk density was lower and hydraulic conductivity was relatively higher at macropores plot than that of the control plot. In addition, plant biomass and total carbon were larger at macropores plot. There was a concern that introduced fresh water with nutrient and oxygen would decompose organic matter. However, enhancing infiltration along with naturally occurred nutrient would positively affect plant growth which subsequently helps carbon storage in soils.

Keywords: Carbon sequestration, Climate change, Infiltration, Macropore, Root channel

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Oral Presentations

Influence of Gliricidia dried biochar amendment on rhizosphere nutrient availability and nutrient uptake of soybean: A column study

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Abstract

Biochar amendment to cropping lands is a promising management tool to increase crop productivity while mitigating soil degradation. Biochar application influences the nutrient availability in soil and other soil properties. Rhizosphere is the root-soil interface that plays a predominant role in nutrient uptake by plants. Rhizosphere nutrient dynamics and its relation to nutrient uptake of crops as influenced by biochar amendment remains poorly understood. A pot experiment was conducted in a greenhouse to investigate the impact of Gliricidia biochar application and incubation period on plant growth and nutrient uptake of soybean (*Glycine max* L.). Plants were grown with (2.5% weight basis) or without biochar amendment coupled with (one month incubation period) or without an incubation period. Rhizosphere nutrient availability, plant growth, uptake of nitrogen (N), phosphorus (P) and potassium (K), and yield parameters were measured. A soil column leaching experiment was conducted separately to test the soil nutrient retention ability of biochar-applied soil. Irrespective of the incubation condition, pod dry weight was significantly increased ($P< 0.05$) when plants were cultivated in biochar-amended soil. There was a tendency of increasing rhizosphere concentration of N, P, and K in biochar-treated soil compared to soil without biochar at physiological maturity of soybean. Further, concentrations of the same nutrients were lower in rhizosphere soil than those in non-rhizosphere soil indicating the plant uptake. Total plant uptake of N, P, and K greatly enhanced under biochar amendment compared with the plants grown without biochar. Without incubation, soybean plant increased its P and K uptake, respectively by 52% and 48% with biochar amendment compared to those without biochar. With incubation, the relevant increases were 42% and 32%, respectively. The results from soil column leaching experiment suggest that the application of biochar in planting media could be an effective way to retain soil N through reducing the leaching losses. At six weeks after planting, N leaching from soil under biochar amendment was reduced by 57% compared to that of soil without biochar. Hence, the results confirm that the application of biochar could increase nutrient availability in rhizosphere and their subsequent root uptake.

Keywords: Incubation, Nutrient leaching, Nutrient retention, Soil improvement

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Effectiveness of a newly synthesized graphene incorporated photocatalyst on degradation of Bisphenol-A and Ciprofloxacin in drinking water

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Abstract

Drinking water is used for many purposes starting from drinking to large food and beverage manufacturing processes. Therefore, it's safety and quality is a critical factor considering increasing of pollution of drinking water sources from various sources. Micro-pollutants are present in these sources leads to health issues among humans. Bisphenol-A (BPA) and antibiotic Ciprofloxacin are major micro-pollutant present in drinking water sources. In the present study, the effectiveness of newly developed graphene-based photocatalyst was tested against degradation of BPA and antibiotic (ciprofloxacin) in drinking water. Halogen lamp (lux=870) was used as the main light source. The powder form of the photocatalytic material was added to drinking water samples and exposed to sunlight. An aliquot was collected from each treatment at every ten minutes to determine the absorbance. Degradation behaviour was further studied by changing pH (5.4, 6.5, 7.3 and 8.2), initial concentration of BPA (from 5 mg/L to 20 mg/L), photocatalyst concentration (from 0.4 g/L to 2.0 g/L) and light source including sun light (from 11.00 a.m to 2.00 p.m), Halogen lamp (lux= 870), and UV lamp (254 nm). The results demonstrated that the highest degradation efficiency for BPA was achieved with 2.0 g/L catalyst concentration (95.5±0.20), 10 mg/L initial BPA concentration (95.70±0.73), pH 8.2 (92.60±2.85) and under visible light sources (95.7±0.73). Ciprofloxacin degradation was effective at 1.0 g/L catalyst concentration (98.13±0.12), with halogen light (97.56±0.12), and sunlight (96.38±0.19). Photocatalytic material was effective in basic pH value compared to neutral and acidic pH values of the drinking water. Compared to UV light, the tested material degrades BPA and Ciprofloxacin above 92% in drinking water samples under visible light. Therefore, graphene-based photocatalyst developed in this study is a nano compound that can be applied to degrade harmful BPA and ciprofloxacin in drinking water sources.

Keywords: Bisphenol-A (BPA), Ciprofloxacin, Graphene-based photocatalytic material

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Use of coconut water for increasing available phosphorus of Eppawala Apatite

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Abstract

Eppawala apatite has low available phosphorus which acts as a barrier to use it as an efficient phosphorus fertilizer. Acidulation is a process which commonly uses to increase available phosphorus in apatite. Biological acidulation is a more environmentally and economically friendly process than chemical acidulation. Coconut water (CW) is a household waste in Sri Lanka with pH < 5.5. CW contains acids such as citric, acetic acids. The objective of this study was to increase the available phosphorus in apatite using CW due to its acidic nature. CW was subjected to ferment under controlled air by covering the CW contained container for three days with monitoring pH. Then apatite + soil mixture was treated in three different ways as Fresh CW, One-day fermented CW, two-days fermented CW using two different types of CW volumes; (a) first, with a minimum CW [Sample (g): CW (mL) = 6:1] to wet the sample (promoting aerobic fermentation) and (b) second with an excess CW [Sample (g): CW (mL) = 3:1] to cover the sample (suppressing aerobic fermentation). Apatite + Soil mixture was used as a controlled sample. Randomized complete block design (RCBD) was used with 3 replicates as an experimental design. Two percent citric acid-soluble phosphate content was measured using the vandomolybdate method with 2-day intervals for 10 days. Data were analyzed by using two-way ANOVA with a 95 % confidence interval. The results revealed that it is having a significant difference ($p<0.05$) of available phosphorus between the controlled and all other CW treated samples which type (a). The highest available phosphorus content (1.52 %) was reported in fresh CW treated samples (controlled showed 0.95-1.1 % of available phosphurus) and it was decreased with time. Results concluded that CW can be used to increase the available phosphorus content with a considerable level in apatite.

Keywords: Available phosphorus, Coconut water, Eppawala apatite

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An approach to reduce application rate of Urea and increase its efficiency in a rice grown tropical Alfisol using rice husk biochar

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Abstract

Fertilizer use efficiency (FUE) of urea in rice cultivation is often less than 30% in Sri Lanka. Losses of urea-N through volatilization, leaching, de-nitrification and runoff cause low profits and multitude of environment issues. The objective of this study was to increase FUE in a rice growing Alfisol in the agro-ecological region IL1 in Sri Lanka using a pelletized urea-rice husk biochar composite (UBC), while reducing the quantity of urea fertilizer application. A field experiment was conducted during 2019 *Yala* and 2019/2020 *Maha* to study the effect of UBC on N uptake (NU), agronomic efficiency (AE) and grain yield of rice transplanted with variety Bg 352. Treatments were: Control (without N), 100 % recommended N as Urea in four applications (100% $Urea_{4app}$), 75 % of recommended N as Urea in four applications (75% N as $Urea_{4app}$), 75 % of recommended N as UBC in four applications (75 % UBC_{4app}), 50% of recommended N as UBC in four applications (50% UBC_{4app}) and 75 % of recommended N as UBC in three applications (75% UBC_{3app}) within the growing season. Treatment 75% UBC_{4app} has given a comparable yield and straw NU to those of 100% $Urea_{4app}$ application (p<0.1). The highest AE was in 75 % UBC_{4app}: 13.1 and 15.2 kg/kg of N in both *Yala* and *Maha* seasons, respectively. Thus, current study proves that 25 % of recommended urea could be cut down in rice cultivated in Alfisols when N is applied in the form of UBC. Neither the rate of urea application nor the number of top dressings could be further reduced through the UBC used for this experiment. Repeated application of biochar through UBC could improve the fertility levels of rice lands in the long-run and this needs to be investigated in future studies using different soils.

Keywords: Nitrogen use efficiency, N uptake, Rice, Rice husk biochar, Slow-release fertilizer

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Impact of soil Nitrogen on below-ground Carbon dynamics of paddy soils in Sri Lanka

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Abstract

Organic carbon accumulation in paddy ecosystems is faster and more pronounced than in other arable ecosystems. The carbon and nitrogen are stored predominately as organic forms in the soil, so mineralization affects both. Soil Nitrogen (SN) can be considered as an essential component of soil carbon sequestration. The combined effect of fresh organic C inputs with low soil N availability leading to a higher SOM mineralization rate and a lower Soil Carbon (SC) storage potential. Hence, soil C responses to N enrichment might play a key role in detecting potential atmospheric CO_2 concentration trajectories. Therefore, the current study was conducted to detect the relationships among soil C, N, and other influential chemical properties associated with C sequestration capacity in paddy soils of Sri Lanka. Conditional Latin Hypercube Sampling design (CLHs) was employed for the study covering all major paddy growing areas (wet, intermediate, and dry zones). One thousand pooled soil samples were collected throughout the country. Soil C and N contents were estimated by using CHN elemental analyzer. Soil pH and Electrical Conductivity (EC) were measured using standard protocols. Statistical analyses were performed using R statistical software. The current study reported the zonal average values of soil C and N contents under wet, intermediate, and dry climatic conditions. The average SC% for the wet zone (n=146) was 5.32 ± 2.82. Meanwhile, the average SC% for the intermediate zone (n= 179) and dry zone (n= 675) were 2.24 ± 0.75 and 1.91 ± 0.82. The average SN% for the wet, intermediate and dry zones were 0.51 ± 0.31, 0.22 ± 0.12 and 0.22 ± 0.17. Specifically, a highly significant, positive linear relationship was found between SC and SN contents ($r=0.73$, $p<2.2$ e-16). Furthermore, significant negative relationships were recorded between SC and pH ($r= -0.38$, $p<2.2$e-16) as well as SN and pH ($r=-0.30$, $p= 2.2$e-16). The study confirms that the increased level of soil N and low pH conditions enhanced the soil C storage potential in paddy soil. Thus, the modest increases in SC resulting from N fertilizer applications up to sensible agronomic rates would be useful in enhancing C sequestration capacity in paddy soils of Sri Lanka.

Keywords: Carbon sequestration, Nitrogen, Organic Carbon, Paddy Soil, pH

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Water-dependent repellency in a Eucalyptus plantation forest soil in upcountry Sri Lanka

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Abstract

Soil water repellency (SWR) is a natural phenomenon reduces the rate of wetting and retention of water in soil caused by the presence of hydrophobic coatings on soil particles. It varies non-linear with the changes in soil moisture content, where the relation can be shown in water-dependent repellency curves (WRC). In general, SWR does not show at soil moisture contents near saturation and increases with drying to a maximum with drying, and may or may not reach non-repellent levels with extreme drying. The WRC, and the parameters associated with the curve, can be used as indicators of the magnitude and the extent of water repellency over changing field moisture contents in soils. The objective of this study was to determine the WRC in a Eucalyptus plantation forest soil in Diyathalawa by gradual drying of soil samples pre-wetted until the disappearance of SWR obtained from 0–5 cm soil layer. The drying process was conducted under controlled conditions of temperature and humidity using a controlled environmental chamber with two temperatures (20 °C, 30 °C) and two RH levels (40%, 60%) separately under four environment scenarios (20 °C, 40% RH; 20 °C, 60% RH; 30 °C, 40% RH; 30 °C, 60% RH). The environment scenarios were selected considering the possible varying environment conditions of the area. While gradual drying, sub samples were taken to measure the moisture content and the SWR using water drop penetration time (WDPT) test, and the WRC was developed. Using the WRC, critical water content (CWC), maximum potential water repellency (MWR), water content at MWR (WC_{MWR}), and area below the curves (A_{WRC}) were determined. SWR at all four conditions varied nonlinearly with decreasing soil moisture. The initial water content at non-repellent wet condition was 35 %. With gradual drying of the soils, SWR appeared, reached a maximum level, and decreased again. Under the four environment scenarios, the CWC were in a range of 27–33%, the WC_{MWR} were in a range of 12–15%, and the MWR were >7200s. Changing in the environment conditions do not cause considerable change in the range of water contents that the soil showed SWR, or the MWR. It can be concluded that the soil will show water repellent conditions at most field moist conditions, except at very wet situation which may occur only in event of extended heavy rainfall to wet the soil, enough to exceed CWC.

Keywords: Eucalyptus, Humidity, Moisture Content, WDPT, Water dependent repellency

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Variability of soil organic carbon and the changes in labile and non-labile fractions in different land uses of *Mahakanumulla* village tank cascade system

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Abstract

Depletion of soil organic matter (SOM) in Village tank cascade system (VTCS) in Sri Lanka has been identified as a major constraint. This study determines the changes in labile and non-labile fractions in different land uses in *Mahakanumulla* VTCS and assess the sustainability of their soil organic carbon management. Soil samples (n=166) were taken from 0-30 cm depth along a longitudinal linear transect and three cross-sectional linear transects at 50 m intervals, representing the distribution of ten tanks and five predominant land uses (paddy, forest, scrub/shrub, upland crops and home gardens). Permanganate oxidizable carbon (POXC) and total organic carbon (TOC) contents of the soil were determined and the lability, carbon pool index (CPI), lability index (LI) and carbon management index (CMI) were calculated. Considerable variability of TOC and POXC was observed between the land uses (CV>25%). Even though the POXC fraction in the soils of the scrub/shrub was 9% lower than that of the forest soils, there was no significant differences. Forests recorded the highest TOC (1.33 ± 0.38%) compared to all the other land uses. The CPI has decreased by 18-33% in lands converted from forests to agricultural lands and home gardens and the highest reduction was observed in paddy lands. However, the highest lability was recorded in paddy soils (0.056) in which the LI also significantly higher than that of home gardens, forest and scrub/shrub. Harvesting practices using combine harvesters, ensure the return of paddy straw back to the same field, rather than burning and submerged conditions might have resulted the higher lability in OC in paddy soils. The CMI of scrub/shrub lands (82.9), previously cultivated with upland crops or as *chena* but now abandoned for about 10-20 years, was significantly lower ($p<0.05$) than that of all the other land use types (98.0 to 103.7) that were not significantly different among themselves. While CMI values indicates that SOM management practices in paddy lands, upland soils and home gardens of the VTCS are sustainable, the need for introducing management strategies such as agroforestry systems combined with the addition of organic matter/amendments for scrub/shrub lands in the VTCS is highlighted.

Keywords: Labile carbon, Soil organic matter, Sustainability, Village tank cascade

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Cyanotoxins in Sri Lankan waterbodies: A case study in Chandrika *wewa* in the Walawa river basin

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Abstract

Cyanobacteria are a highly diverse group of prokaryotes and some of them release toxins (cyanotoxins) into their aquatic habitats. Due to high toxicity, tendency to bioaccumulate and biomagnify, cyanotoxins may risk human and animal health. Chandrika wewa (448 ha) supplies drinking water for more than 5000 families in the Walawa river basin. However, a systematic study has not been conducted to detect cyanotoxin contamination in the reservoir. Therefore, the objectives of the present study were (a) to confirm the presence or absence of cyanotoxins and (b) to identify the impacts of physicochemical parameters of water on spatial distribution of cyanotoxins. Sub-surface water samples were collected from 33 sites representing the entire reservoir and subsequently NO_3^--N, PO_4^{3-}-P, cyanotoxins, chlorophyll-*a* and phytoplankton composition were measured. The concentrations of two cyanotoxins, microcystin (MC) and nodularin (NOD) were determined by using enzyme-linked immunosorbent assay (ELISA). *In-situ* physiochemical properties were measured using a multi-parameter water quality meter. Results showed the presence of phytoplankton in the genera of *Tribonema*, *Microspora*, *Pediastrum* and *Microcystis*. *Microcystis* was dominant in all sampling sites with the density of 200-790 cells/mL. The MC and NOD concentrations were between 0.77-1.19 µg/L and 0.69-1.27 µg/L, respectively. Further, absence of filamentous cyanobacteria that is resembles to the morphology of the members in the genera of *Nodularin* was confirmed. However, there were significant positive correlations between MC (r^2 = 0.992, $p<0.05$) and NOD (r^2 =0.883, $p<0.05$) concentrations with *Microcystis* density. Therefore, it can be assumed that NOD is unlikely to be present in this reservoir and the detected NOD is due to the cross reaction of NOD antibodies with MC in water samples. Further, filamentous cyanobacteria that are known to produce MC was not found. Hence, *Microcystis* is likely to be responsible for the detected MC toxin. There was no correlation between any of the physicochemical parameters with the spatial distribution of MC toxin. The concentration of MC in this reservoir was slightly above the World Health Organization (WHO) guidelines for drinking water (1 µg/L). Therefore, continuous monitoring of toxins and physicochemical parameters of the reservoir is recommended to minimize cyanotoxin associated health hazards that could happen in the future.

Keywords: Cyanobacteria, ELISA, Microcystin, Nodularin

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Poster Presentations

Phosphorus uptake and use efficiency of mung bean in response to moisture and phosphorus co-limitation

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Abstract

Crop yields are significantly reduced by phosphorus (P) deficiency and drought stress in many cropping systems worldwide. Legume crops are considered as an integral component to sustain the productivity of many cropping systems, where mung bean (*Vigna radiata* L. Wilczek) is recommended as a mid-season crop in selected paddy fields in Sri Lanka by the Department of Agriculture, as an approach to utilize residual moisture. The present study explored the growth performance, P uptake and yield parameters of two mung bean varieties: MI5 and MI6 grown under moisture and P co-limited conditions. Plants were cultivated in pots containing 15 kg soil under two P levels (with and without P application) and two moisture levels (well-watered and water-stressed) imposed during the reproductive growth. The experiment was done as a three factor factorial in completely randomized design with three replicates. Biomass and P accumulation in different plant organs and yield parameters were measured. Plant dry weight, P uptake, and the yield of both varieties were remarkably reduced when plants were exposed to moisture stress and P-deficiency stress. For both varieties, the highest tissue-P concentration was attained with P application under well-watered condition whereas the lowest was recorded from plants under moisture stress and without external P supply. MI6 showed the better ability to acquire more P than MI5 when grown without external P supplement. Increased phosphorus use efficiency (PUE) was shown by the two varieties tested under P-deficient conditions. Across all treatment combinations, MI6 had the highest PUE under water stress and without P application, and also produced a greater pod dry weight compared to MI5 in P-deficient soil. Other yield parameters such as number of pods per plant, pod length, and number of seeds per pod were also greater in MI6 than those of MI5 particularly under well-watered condition. Results clearly demonstrated that co-occurrence of P-deficiency and moisture stress could bring significant yield reduction ($P<05$) in mung bean. Among the two varieties used in the study, MI6 seems to thrive well under P-limited conditions in the absence of soil moisture stress.

Keywords: Drought stress, Phosphorus-deficiency, Yield parameters

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Assessment of Cd, Cr and Pb concentrations of soil, roots and leaves of *Centella asiatica* cultivations at Padaviya area in Anuradhapura District.

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Abstract

This study was conducted to assess the Cadmium (Cd), Lead (Pb) and Chromium (Cr) concentrations in *Centella asiatica* (Gotukola) harvested from chemical fertilizer applied irrigated cultivation sites in Padaviya area in Anuradhapura District during rainy and dry seasons. In the present study, Cd, Pb and Cr were selected as they are the mostly concerned heavy metals associated with the chronic kidney disease prevalent in the Padaviya area during the past decade. The area contained sandy loam soil and has been using chemical fertilizers for more than 10 years. Heavy metal concentrations in soil (Cd*soil*, Cr*soil*, Pb*soil*), roots (Cd*root*, Cr*root*, Pb*root*), and leaves (Cd*leaves*, Cr*leaves*, Pb*leaves*) of *Centrella asiatica* were analyzed using atomic absorption spectrophotometer (graphite furnace method) after acid digestion. The heavy metal concentrations during the rainy and dry seasons were compared using student t-test at 95% level of significance to assess the seasonal variation of heavy metal concentrations. MINITAB 14 software was used for statistical analysis. Only mean Cd*soil*, Cd*leaves* and Pb*root* during dry season (0.21±0.05, 0.72 ± 0.11 and 0.59 ± 0.12 mg/kg) were significantly lower than that of the rainy season (3.40±0.60, 2.61±0.53 and 2.35 ± 0.46 mg/kg) among selected metals. The mean Cr*soil*, Cr*root*, Cr*leaves*, Cd*root*, and Pb*leaves* concentrations in dry season (23.20±4.15, 12.76 ± 3.19, 7.34±1.28, 0.96 ± 0.10, 1.85±0.69 mg/kg) was significantly higher than that of the rainy season (22.44±4.21 , 8.04 ± 0.90 , 6.09±0.46, 0.60 ± 0.13, 1.75±0.50 mg/kg). However, mean Pb*soil* during the dry season (3.40±0.60 mg/kg) was significantly lower than that of the rainy season (4.93±0.80 mg/kg). Soil heavy metal concentrations were below the EU recommended safe limits (Pb:300 mg/kg; Cr: 180 mg/kg; Cd:6.4 mg/kg) during both sampling events. The mean metal concentrations of leaves exceeded the WHO/FAO safety limits for consumption of green leafy vegetables during both sampling events. (Cd: 0.2 mg/kg, Cr: 2.3 mg/kg and Pb: 0.3 mg/kg). Mean metal concentrations followed the pattern Cr>Pb>Cd in all plant parts and soil during both seasons. The mean bio-concentration factor of the heavy metals followed the order Cd > Pb> Cr during both seasons. The mean translocation factor indicated accumulation of Cr and Cd in the roots of *C. asiatica* and accumulation of Pb in the leaves of *C. asiatica*. Variations in the concentrations of the heavy metals in *C. asiatica* in this study can be ascribed to the chemical and physical characteristics of the soil of the cultivation sites due to long term fertilizer application, atmospheric deposition of heavy metals and the deposition of contaminated irrigation water.

Keywords: Bio-concentration factor, Heavy metals, Leafy vegetables, Translocation factor

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Assessing microplastics in water and sediment at river mouth of Nilwala basin

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Abstract

The amount of mismanaged plastics entering into the aquatic system has increased with the demand for synthetic plastics around the world. Among these plastics, particles with a diameter less than 5 mm are defined as Microplastics (MP). There exists a gap in documented types of MPs that contribute to plastic pollution in coastal waters. Therefore, the aim of this study was to evaluate the MP content at the Nilwala River mouth, Sri Lanka. Investigations were carried out for three consecutive months from January 2020, by collecting samples bi-weekly. A total of 162 water samples collected from bulk sampling and 54 sediment samples collected using Ekman grab were collected from three sites (S1, S2 & S3) located with a gap of 1 km in between starting from the river mouth to upstream. Samples were filtered using a 30 µm mesh sieve and digested using 30% H_2O_2. Finally, the samples were filtered using Glass Fiber grade C (GF/C) filter papers and observed under a stereomicroscope. Identification was carried out using Nile Red analysis and or hot needle test. The shape and color of MPs were recorded. The mean abundance of MPs in water was 93.85± 32.63 particles per liter of water sample, while the minimum and maximum values recorded were 64 and 130 particles per liter of the water sample. In sediment, it was varying from 69 to 140 with a mean value of 102.85±40.07 particles per kg of dry weight. Of those 3 months results, the highest MP particle abundance was recorded in February for water and in January for sediment. Of the different shapes of MPs observed, fibers were the most abundant as 71% in water and 67% in sediment. The most recorded color of MP was blue colored fibers and fragments in both sediment and water samples. The highest mean abundance of MPs was recorded as fibers (109.33 ± 24.70) particles per liter of the water sample from site 2 in February. There was no significant difference of mean abundance in the types of microplastics in water and sediment samples among the three sites ($P>0.05$). More studies are needed to make a comprehensive assessment of MP pollution in Nilwala river basin.

Keywords: Aquatic pollution, Microplastic, Nilwala basin, River mouth, Sediment contamination

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Comparison of extraction and detection methods of exchangeable Potassium in paddy soils in Sri Lanka

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Abstract

Extracting potassium (K) with ammonium acetate (AA) and detecting under flame photometer (FP) is widely used to determine the exchangeable K concentration. Moreover, calcium chloride (CC) is used as a universal extractant (simultaneous extraction of many elements) and the concentration of these elements are detected using inductively coupled plasma emission mass spectrometry (ICP-MS). Therefore, this study aimed to examine the relationship between 1 M AA extracted K detected using the FP method and 0.01 M CC extracted K detected using the ICP-MS method. A total of 250 soil samples were collected from lowland paddy fields in Sri Lanka representing three climatic zones and 19 districts. Extraction and detection protocols of K were as mentioned above. Results revealed that the mean exchangeable K detected by ammonium acetate-flame photometer (AA-FP) method was greater (250±9.2 mg kg^{-1}) than the calcium chloride- ICP-MS (CC-ICP-MS) method (64±3.4 mg kg^{-1}). Concentration of K determined by AA-FP method ranged from 34 mg kg^{-1} to 803 mg kg^{-1} while that by the CC-ICP-MS method ranged from 0 mg kg^{-1} to 373 mg kg^{-1}. The relationship between the exchangeable K by the AA-FP method and CC-ICP-MS method was K (CC-ICP-MS) = 0.288 × K (AA-FP) −7.25 with a R^2 value of 0.58 ($P<0.001$). Therefore, CC-ICP-MS can be used as a reliable and convenient method to determine the exchangeable K in paddy soil in Sri Lanka.

Keywords: Ammonium acetate, Calcium chloride, Exchangeable potassium, Flame photometer, ICP-MS

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Potential of selected underutilized organic residues and Azolla, *Spirulina* grown in wastewater as plant nutrient sources

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Abstract

Inorganic fertilizer usage leads to economic losses and environmental issues. Limited knowledge and availability of organic fertilizers is one of the reasons for excessive inorganic fertilizer usage. Though phosphorus and potassium are rich in plant residues, their nitrogen content is poor. Azolla (Az) and *Spirulina* (Sp) are nitrogen-rich sources grown in water, which is a scarce resource. In this background, a study was conducted aiming to formulate low-cost medium using wastewater to produce *Spirulina* and Azolla and analyze different organic nutrient sources, namely, Palmyrah leaf (Pl), Coconut leaf (Co), Banana pseudostem (Bp), Az and Sp. Biomass yield of *Spirulina* was assessed with different combinations of wastewater and standard Zarrouk's medium (Zm) with two replicates and six treatments, namely, T1- 100% Zm, T2- 50% Zm, T3 - 50% Zm + 50% Parboiled effluent, T4 - 50% Zm + 50% Reverse osmosis wastewater (ROw), T5- 50% Zm + 50% Seawater, T6 - 50% ROw. Azolla was assessed with different combinations of wastewater and freshwater with two replicates and nine treatments, namely, T1 - Kitchen wastewater (Kw) + Triple superphosphate (TSP), T2- Tap water (Tw) +TSP, T3- ROw + TSP, T4 - Kw + Cow dung (Cd), T5 - Tw +Cd, T6 - ROw + Cd, T7 -Kw, T8 - Tw, T9 - ROw in completely randomized design (CRD). Macronutrient (carbon, nitrogen, phosphorous, potassium, calcium, and magnesium) content of organic sources Az, Sp, Co, Pl, and Bp were analyzed with three replicates in CRD. The recorded data were statistically analyzed using ANOVA, and mean separation was done using Duncan Multiple Range Test. Results of nutrient analysis of organic sources indicated that significantly higher potassium (19.56 mg/kg), phosphorous (6.17 mg/kg), nitrogen (115.03 mg/kg), carbon (832.50 mg/kg), calcium (10861 mg/kg) and magnesium (1947.2 mg/kg) were found in Banana pseudostem, Banana pseudostem, *Spirulina*, Palmyra leaf, Azolla, and Azolla, respectively. By substituting 50% Zm with parboiled effluent (3.02 g/L) or ROw (2.8 g/L) gave significantly higher and comparable *Spirulina* dry biomass respectively to that of 100 % Zm (2.809 g/L). Significantly higher dry biomass yield was obtained in Azolla when Kw or ROw was used instead of freshwater. Results therefore indicated that the tested underutilized organic sources and nitrogen sources grown in wastewater are potential plant nutrient sources.

Keywords: Azolla, Banana pseudostem, Coconut leaf, Palmyra leaf, *Spirulina*

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Effect of Water Hyacinth (*Eichhornia crassipes*) compost mixtures on growth attributes of Chilli (*Capsicum annuum*)

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Abstract

Production of compost by water hyacinth (*Eichhornia crassipes*) is an effective solution to overcome the problems caused due to its invasive growth in water bodies. The objective of this study was to evaluate the effectiveness of various compost mixtures produced by water hyacinth on the growth performance of Chilli (*Capsicum annum*) var. MI-2. Six compost trials were prepared using different ratios of water hyacinth, cattle manure, spent poultry litter, Eppawala rock phosphate, wood ash and dry leaf litter. Compost production and the greenhouse experiment were done in the Faculty of Agriculture, University of Ruhuna. Two kilograms of top soil (Ultisols) were filled to the polyethylene pots and supplemented with the basal dressing (Urea 0.047 g/pot, Triple super phosphate 0.134 g/pot, Murate of potash 0.1 g/pot) according to the Department of Agriculture recommendations and allowed to stand one week before the plant establishment. The prepared compost mixtures were incorporated into the soil according to the field application rate of 20 MT/ha (26.87 g/pot) in 7 treatments including a control treatment replicated without applying any compost mixture. *C. annum* seedlings were established in pots with three replicates and were laid out in a Complete Randomized Design in the greenhouse. The shoot length (cm) was recorded every other day for 6 weeks. Root dry weight (g), Root length (cm) and shoot dry weight (g) was recorded at the end of the experiment. According to the results, it revealed that the compost mixtures were significantly ($p \leq 0.05$) influenced the growth of *C. annum*. The best shoot length was obtained in treatment 5 which the soil was amended with compost consists of water hyacinth 50%, dry leaf litter 25%, Eppawala rock phosphate 5%, wood ash 5%, and spent poultry litter 15%. Further, the shoot dry weight of C. annum was significantly ($p \leq 0.05$) increased when the soil was amended with the same compost mixture. Therefore, it can be concluded that water hyacinth composted by mixing different amendments can be used to prepare organic fertilizers effectively as a nutrient source for *C. annum* growth.

Keywords: Dry leaf litter, Eppawala rock phosphate, Greenhouse, Spent poultry litter, Wood ash

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Stability and erodibility of model aggregates as affected by water repellency and heating duration

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Abstract

Soil water repellency is commonly observed with some plant species (ex: pines, casuarina, eucalyptus, etc.) that are highly vulnerable to wildfires. The heat generated by these fires can alter the physical properties of soil aggregates influencing the erodibility of soil. These alterations can be highly dependent on the temperature as well as the duration of heating. This experiment aimed to investigate the effects of heating durations and the water repellency (WR) level on water stability of aggregate (WSA%) and the floating time (FT) when immersed in water, for water repellent model aggregates. In this experiment, non-repellent soil (Rhodudults) was hydrophobized using powdered dried *Casuarina equisetifolia* leaf-litter (CE) at two different rates (T1:10% CE; T2: 25% CE) to obtain two WR levels, with a control (T0: 0% CE). Model aggregates, prepared using acrylic cylindrical blocks, were subjected to three heating durations (30, 60, 120 min) at 150°C temperature with at 400°C/h heating rate. The WSA%, FT, and WR, of heated and non-heated aggregates were measured. Data were analyzed considering complete randomized design (ANOVA; $p \leq 0.05$). Control aggregates were non-repellent and not floated before and after heating. Before heating, T1 aggregates were slightly repellent and not floated, while T2 aggregates were slightly repellent and floated (~15s). After heating WR, as measured by water drop penetration time (WDPT), increased from ~2 s to ~15 s in T1, and from ~10 s to ~70 s in T2. After heating, FT increased up to 1-2 s and 70-170 s, respectively, in T1 and T2, compared to 0 s in control. However, both repellency and floating time of those aggregates decreased with the increasing heating duration. The WSA% of both repellent and non-repellent aggregates increased after heating and the percentage increase in WSA% decreased with the increasing heating duration. The percentage increase of WSA% at 30, 60, and 120 min durations, respectively, were 5.07, 3.48, and 1.7% for T0, 5.91, 4.91, and 3.14% for T1, and 9.84, 9.24, and 8.1% for T2. Strong positive relationships were observed between WSA% and WR for both T1 (R^2 = 0.90–0.99) and T2 (R^2 = 0.88–0.97) samples under all three heating durations. Aggregates of T2 showed the highest WR, FT, and percentage increase of WSA%, of all aggregates. Higher WR, FT, and percentage increase in WSA% was observed at 30 min heating duration than at 60 and 120 min. Water-repellent aggregates heated around 30 minutes seemed to have more potential to be eroded via surface run-off than non-repellent aggregates. Further experiments are required to determine the effects of different heating temperatures.

Keywords: Floating time, Heating duration, Water repellency, Water stability of aggregates

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Screening traditional rice accessions for salinity tolerance at the seedling stage in a hydrophonic solution

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Abstract

Salinity is one of the worst abiotic stresses that restricts the cultivable paddy-land areas in the tropics. Sri Lanka inherits a traditional rice gene pool that contains the most important traits. This study was carried out to screen 25 traditional rice accessions for salinity tolerance at the seedling stage in Yoshida solution. Dormancy broken, surface-sterilized seeds were germinated in distilled water for 3 days and germinated seeds were transferred to Yoshida solution with EC 3 dS/L for 3 days. After 3 days, seedlings were transferred to Yoshida solution with EC 6 dS/L and seedlings were kept in the same solution for 16 days. On the 10th day and 16th day at salinity treatment, plants were evaluated according to the visual scoring system adapted by IRRI. The control experiment was carried out in the Yoshida solution. Two Pokkali accessions were used as positive controls. At the end of the experiment, shoot and root dry matter reduction rates compared to that of control plants were recorded. Data were analyzed using SPSS. Among the tested 25 traditional rice accessions Kaluwee (3728), Pokkali (3573, 3567), Rathuwee (3905), and Rathu heenati (4992) were highly tolerant while Heenati (3998), Kaluheenati (4621), Murungakayan (3489), Polayal (93661), Ratawee (3466, 3473), and Suduhenati (7799) were tolerant at the 10th day of the stress treatment. By the 16th day of the salinity stress, Rathu heenati (4992) accession was highly tolerant, and Kalu wee (3728), and Pokkali (3573, 3567) accessions were tolerant. Two principle components (PC) were extracted in factor analysis that explained 51% and 32% variance, respectively. According to the hierarchal cluster analysis, four different clusters were identified at the cluster distance 5. Fifty-four per cent of the visual score, 85.4% of root dry matter reduction rate and 70.8% of shoot dry matter reduction rate contributed for PC1. The present findings are very much important for utilizing traditional rice accessions for future rice improvement programs for salinity tolerance.

Keywords: Salinity tolerance, Seedling stage, Traditional rice

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Innovative Technologies

Keynote Speech

Freshness evaluation of leafy vegetables for the sustainable world

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This keynote will introduce the challenges we have tackled so far. Freshness of fruits and vegetables is often judged by appearance, such as their color change and wilting, and is sometimes classified into the secondary function of food, namely preference characteristics. However, a concept of freshness involves degrees of the fulfillment of primary (nutritional) and tertiary (healthful) functions. Recently, several researchers have tried to define freshness by capturing components that reflect the history of postharvest physiological conditions. These attempts are so-called searches for freshness markers, and some substances or genes have been proposed as the marker candidates so far. Our research team also have attempted to give a scientific definition of freshness. We are focusing on the dysfunction of cell membranes because altered membrane properties are the key event leading to a cascade of unfavorable biochemical reactions culminating in freshness deterioration. In this study, membrane damage during storage was evaluated by the chemical, mechanical, and transport properties of the cell membrane. Hydroponically cultivated spinach leaves (*Spinacia oleracea* L., cv. 'Orai') was stored under 5 %, 10 %, and 20 % oxygen concentration at 20 °C in the dark environment for 4 days. Malondialdehyde (MDA) equivalent, membrane tension at protoplast bursting (γ), and hydraulic conductivity coefficient (Lp) were measured over time during storage. We also tackled nondestructive measurement for membrane damage using near infrared spectroscopy (NIRS). Results showed that low oxygen conditions suppressed the changes in all three measures. MDA equivalent was linearly correlated to the γ. MDA equivalent was a leading indicator of the increase of Lp. These findings indicated that the measurements of membrane integrity would be valuable indicators for the freshness of spinach leaves, and MDA equivalent was the most useful indicator for membrane damage among the measures we investigated because it required protoplast isolation for measuring the γ. NIRS could estimate MDA equivalent with more than 0.6 of R-squares, which provided supporting information to evaluate the remaining shelf life. Our obtained knowledge will serve as a foundation for developing a freshness evaluation theory based on the dysfunction of cell membranes and will contribute to promoting an innovative technology for keeping freshness in fruits and vegetables.

Keywords: Lipid peroxidation; Membrane integrity; Nondestructive evaluation; Water permeability

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Oral Presentations

Performance evaluation of selected vegetables and fruits waste by using double chamber microbial fuel cell

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Abstract

Microbial fuel cells technology is the most attractive alternative energy source to generate bioelectricity from wide range of substrates by using bio electro-genic microorganisms. It has special interests on supply the energy demands for small devices by using waste materials. In this study a prototype double chamber microbial fuel cell was developed with copper as cathode and anode electrodes and salt bridge as the proton membrane. The performance of microbial fuel cell was tested with the substrates extract from waste vegetables and fruits such as tomato, pumpkin and banana to generate bioelectricity over a testing period of 30 days and without renovation of substrates in the batch mode operation. Results revealed that the average value of open circuit voltage for tomato, pumpkin and banana were 382.59, 370.92 and 358.06 mV, respectively. The peak voltage of tomato is 700 mV. The output voltage depends on reaction of microorganisms, electrode and environmental conditions. The micro-organisms growth and multiplication period, the output voltage is high and the output voltage pattern over the tested period shows good agreement with growth pattern of microorganism.

Keywords: Double chamber, Electricity, Microbial fuel cell and Microorganism

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Effect of light spectrum from Light Emitting Diode (LED) on postharvest fruit quality of Tomato (*Solanum lycopersicum L.)*

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Abstract

Tomato (*Solanum lycopersicum* L.) is one of the higher-ranking commercial vegetable crops in the World. This study was to investigate the effect of different colours such as blue, red, yellow, green, and white light of LED lighting and dark condition (control) on postharvest quality and microbial growth on harvested tomato fruits. Experiment was conducted in complete Randomized Design in laboratory providing lighting with light intensity of 5555.5-8333.3 lux/m^2 in 30 cm x 22 cm x 30 cm cardboard boxes with temperature range of 25 ^{0}C-28 ^{0}C and relative humidity of 80%. Fruit quality parameters were studied such as fresh weight loss, pH, total soluble solid (TSS), hardness, lycopene, total carotene, ascorbic acid and *in vitro* microbial growth under different colours of LED light. At the 25th day of storage, fresh weight loss % significantly high in blue LED light (11.08±1.141%) and the lowest value was recorded in control (6.20±1.41%). At 9th day L* value significantly high under the control (58.01±1.849) than other treatments. L* value significantly high under the white LED light in 17th (52.42±1.10) and 19th (49.08±1.7) days than others. a*and b* values of colour, hardness and pH were not significantly varied under the LED lights and control throughout the storage. On 25th day the highest TSS was recorded (4.50± 0.52%) in blue LED light whereas, the lowest TSS was recorded in white (3.5±0.52%). The highest lycopene content was recorded in red LED light in 21th (178.56±3.59 mg/kg) and 25th (237.35±22.8 mg/kg) days. The lowest Lycopene content recorded in green LED light in 21th (65.373± 3.59 mg/kg) and 25th (90.53±22.8 mg/kg) days. At 21st day the highest carotene content was recorded in red LED light (0.3461±0.0047 mg/kg). The lowest carotene content was recorded in green light treatment (0.1274±0.047 mg/kg). 1st (0.177±0.048cm) and 2nd (0.333±0.074cm) days after inoculating the highest *in vitro* microbial colony growth was recorded in control and there was no *in vitro* microbe colony growth in LED light treatments in 1st and 2nd days. LED light colour mainly red, white, and blue considerably effect on postharvest fruit quality of tomato such as fresh weight loss %, lycopene content, total solid content (TSS), and total carotene. LED light spectrum effectively suppressed microbial growth on fruit surface especially red light which evident by delaying of microbial growth in *in vitro* microbial study.

Keywords: Fresh weight loss, *In vitro* microbial growth, Lycopene, Total carotene, Total Soluble Solid

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Properties of commercially available antiscalant and their impacts on discharge water of reverse osmosis

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Abstract
Usage of antiscalant is widespread in reverse osmosis plants as it has a great advantage in preventing the scale occurrence; thus, it improves the performance of the operation. However, studies evaluating the properties and impact of antiscalants on the environment and living organisms are not much inaugurated. From the reverse osmosis process, only 50 to 80% of water can be converted into drinkable quality, and an excess of 20 to 30% of water containing antiscalants and other chemicals are discharged to the environment. This study was to analyze the physical properties of pH, EC, TDS and DO and chemical properties of phosphate, sulphate, nitrate and chlorine of four various commercially available A, B, C, and D antiscalants and to assess their impact on the ecosystem when discharged into the environment. Most of the commercially available antiscalants are acidic with pH values vary from 2 to 4, however, antiscalants with an alkaline property also can be found, such as antiscalant B with 10.8 pH. When releasing the antiscalants into the environment, antiscalant A, C, and D mainly contain $18.2 * 10^{-3}$ kg m^{-3} of nitrate, $1.5 * 10^{-3}$ kg m^{-3} of sulphate and $1.40 * 10^{-3}$ kg m^{-3} of phosphate. These amounts are alarmingly high in comparison with International Water Quality Standards. Bioassay test was conducted using Azolla pinnata in synthetically produced discharge water contaminated with antiscalant. When the concentration of the antiscalants increases from 0.00 mL/L to 0.1 mL/L, the absorption value of chlorophyll extracted by 80 % of acetone was continuously fallen; thus, it shows that chlorophyll content will reduce with the increment of concentration of the antiscalants. Absorption reduction of antiscalants type A, B, C, and D was observed with their control 46.54%, 26.21%, 31.08%, and 30.22%, respectively. The absorption rate was decreasing throughout the observation period of four weeks, which proves that antiscalants are persistent for a long time in a water body. Biofouling test was conducted by using *Pseudomonas aeruginosa*. Cell density of *Pseudomonas aeruginosa* was increased in antiscalant A and antiscalant B. Therefore, antiscalants positively effect on RO membrane by microbial growth. Though the negative impacts of antiscalants on the environment and living organisms are significantly high, the need of antiscalants in reverse osmosis operation is inevitable.

Keywords: Antiscalant, Azollapinnata, Discharge water, Property test

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Investigating the performance of blends of diesel and alcohol in a single cylinder diesel engine

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Abstract

Ethanol can be considered as a renewable source of fuel and it is a nontoxic type of fuel. Currently, Ethanol is not utilized as a fuel in Sri Lanka and production is done as a byproduct of sugar production using molasses. Due to its economic value in the alcohol beverage industry, it has a high market value because of TAX. Although its production cost is far less than any other commercial fuel that has been used in the country. Anyhow since the world is using low carbon alcohols as a fuel and a blend with gasoline exclusively for the low cost and clean emission, there is viability to use it with diesel. The most prominent issue that comes up with this blend is that both fuels are immiscible at ambient conditions and in an improved condition behave as a microemulsion. Due to that reason, the fuel blend should come up with an emulsifier. In this research, the main objective was to investigate the applicability of blends of diesel and ethanol (Diesanol) in diesel engines while minimizing the fuel consumption irrespective of the immiscibility of the two fluids. The overall objective of the research was to propose to use ethanol as a green fuel to reduce emission in diesel vehicles as a sustainable fuel while keeping the vehicle performance. To test the stability of the mixture while using a covalent emulsifier biodiesel a series of tests was designed. The tests were done using commercially available anhydrous ethanol and diesel. Biodiesel was produced by transesterification of used cooking oil. To fulfil the continuous supply of a perfect blend of fuels to the engine a blending machine should be developed. According to the performance of the engine, it is found that increasing the percentage of ethanol up to 15% can reduce fuel consumption.

Keywords: Diesanol, Emission, Ethanol, Fuel Consumption, Renewable Fuel

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Experimental investigation of internal combustion engine performance using biodiesel produced from used cooking oil

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Abstract

Biodiesel allows people to burn a cleaner form of energy and it is sustainable, renewable, non-toxic, and free from Sulphur and aromatics over petroleum fuels. The biodiesel production begins with a lipid source and it can be harvested from edible oil, non-edible oil, or animal fat. The lack of dissemination of knowledge has been caused for the reusing of waste cooking oil, and there is no alternative in the milieu of Sri Lanka. Therefore, experimental investigation on biodiesel production with waste cooking oil has been conducted with the aid of a modified mini biodiesel production plant with a transesterification method. This plant was capable of 20 litres of bulk production at once and the system comprises all processes to get purified biodiesel as final output. Then, the properties of produced biodiesel were tested and engine parameters were calculated under different mixing ratios with diesel (B0, B10, B20, B30, B40, B50, B75, and B100). The physical properties were compared with European standard EN14214. The flashpoint of B100 deviates from the standard whilst all other samples satisfy the standard. Further, the density of all blends lies between the standard range. Specially, the brake thermal efficiency and brake specific fuel consumption of B100 has remarkable deviation than other samples. Besides that, the exhaust temperature of the internal combustion engine increases with the applying load and tiny fluctuation appears with the standard exhaust temperature. Specifically, by considering each expense, it could be able to estimate the cost of the biodiesel per one litre, which was 84.5 LKR. The results promising that the produced biodiesel can use as a fuel to produce electrical power sustainably and alternatively over diesel.

Keywords: Biodiesel, Free Fatty Acid, Renewable Energy, Transesterification, Used Cooking Oil

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In-silico promoter analysis and cloning of *OsBBX6* gene towards the development of multi-stress tolerant rice varieties

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Abstract

Rice growth and productivity are seriously limited by several abiotic stresses; temperature, UV-B radiation, drought, salinity and oxidative stress. It has been reported that *Arabidopsis* B-box proteins (BBX) play a key role in light and abscisic acid insensitive abiotic stress regulation pathway indicating that BBX protein could be an ideal candidate to develop multi-stress tolerant crops. However, only a few rice BBX genes have been functionally characterized. *In-silico* designing and simulating cloning protocols in genetic engineering can enhance the accuracy of procedures. The main aims of this study were to identify the abiotic stress regulatory cis-acting element on *OsBBX6* promoter and simulate *in-silico* cloning of *OsBBX6* coding sequence (CDS). *Oryza sativa indica* upstream sequence (1.0 kb) of *OsBBX6* (GenBank: CM000129.1) was retrieved from the NCBI database. PlantCARE and New PLACE tools were used for screening of cis-acting elements. Abiotic stress responsive elements namely salinity stress (GT1GMSCAM4, MYBCORE), dehydration (MYB2CONSENSUSAT, CBFHV, MYBCORE), light (G-Box, GT1-motif, I-box, Sp1, Box 4) and hormone (ABRE, DPBFCOREDCDC3, CGTCA-motif, TGACG-motif) were identified on the *OsBBX6* promoter region. Occurrence of cis-elements related to dehydration and salinity stress, dehydration and abscisic acid in *OsBBX6* promoter are two to five. Other abiotic stress responsive elements occur once in the *OsBBX6* promoter. PCR simulated by SnapGene using forward primer (5'CCCATGGCGATGAAGGTGCAGTGCGACGTG3') and reverse primer **(**5'CGGTAACCTCACCAGTAGGAGTAGGAAGAAG3') amplified the 830 bp *OsBBX6* CDS. Restriction cloning of CDS into pCAMBIA1303 at *Nco*I-*BstE*II restriction sites were carried out by using SnapGene. This simulation showed that the *OsBBX6* CDS in the recombinant plasmid (pCAMBIA1303-OsBBX6) is in frame and therefore, 35S promoter can successfully over-express *OsBBX6* CDS after *Agrobacterium* mediated transformation into rice. Furthermore, this simulation shows that *Nco*I and *BstE*II cleavage sites are not blocked by Dam methylase and Dcm methyltransferases after cloning. Therefore, *E. coli* DH5α can be used for transformation of the pCAMBIA1303-OsBBX6 recombinant plasmid. Taking together, *in-silico* analysis revealed that *OsBBX6* have a putative role in drought and salinity stress regulation and could be a possible candidate to develop multi-stress tolerant rice.

Keywords: Cloning, BBX genes, Simulation, *In-silico*, Promoter

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Poster Presentations

Study the influence of UV-C radiation on growth of corn (*Zea mays*)

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Abstract

The concern of the depletion of stratospheric ozone has led to a number of studies and increase in ultraviolet (UV) radiation may have a negative influence on the productivity of terrestrial ecosystems. In this study, seeds of corn (*Zea mays*) were exposed to UV-C radiation of 253.7 nm for different time durations 5, 10, 20, 30 and 40 minutes, separately. The corn plants were selected in this study because they can easily grow at any conditions. The exposed seeds, along with untreated seeds, were sown in plastic pots filled with autoclaved sand in three replicates with completely randomized design under plant house. Data were statistically analysed by Analysis of Variance (ANOVA) using a SAS statistical package. Seedlings were harvested after sixteen days of seed sowing. Biological (Root length, Shoot length and Chlorophyll content) and physical characters (Electrical conductivity, Refractive index and pH) of plants were measured. There were no significant differences observed in shoot lengths of seedlings produced by treated and untreated seeds (control). However, significant differences ($P<0.0001$) among treatments were observed for root lengths. Seedlings from the seeds exposed to 20 minutes of UV-C radiation had the highest root length (mean 25.8 cm), while seedlings grown from the seeds exposed to 30- and 40-minutes inhibited root growth. The total chlorophyll content of the plants gradually increased with increasing exposure times and the significantly higher chlorophyll content of (mean 5.3 $mgmL^{-1}$) was recorded in seedlings from 40 minutes of UV-C treated seeds. Average pH values of seedling extract significantly ($P<0.0001$) increased from the seeds exposed to 20 minutes. Further, electrical conductivities of the plants almost linearly increased with their exposure time. Exposure of UV-C radiation to the corn seeds at different time intervals affect the physical and biological factors of seedling of the plants.

Keywords: Chlorophyll content, Electrical conductivity, Seedling characters, Time duration

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Comparison of net energy potential between bio-ethanol and lipid extraction derived from *Chlorella vulgaris*

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Abstract

Proper implementation of sustainable energy sources in developing countries could decrease their dependence on natural gas, oil, and investments in renewable energy technologies would be more cost effective than fossil fuels. The first and second bio fuel generation biomasses have been used as a feedstock to produce biofuels, which cannot satisfy the worldwide demand. Therefore, as the third biofuel generation, algae are viewed as a promising feedstock for the production of various kinds of biofuels such as bio-ethanol, biodiesel, and lipid. There were very few researches related to the energy comparison of biofuel production from microalgae. Therefore, this research was conducted to compare the net energy potential between bio-ethanol and lipid extraction derived from *Chlorella vulgaris.* For this comparison, *Chlorella vulgaris* was cultivated in photo-bioreactor using Bold's basal medium and harvested by sedimentation and centrifugation at 4500 g for 10 minutes. Initially, five grams of the same amount of biomass was used for the production of bio-ethanol and extraction of lipid. Bio-ethanol was prepared using alkaline pre-treatment method under 0.75 % of NaOH (w/v) and heated at 120 ^{o}C for 30 minutes. Yeast was cultured in LB medium and used to ferment the pre-treated microalgae in the incubator for 96 hours at 30 ˚C at 200 rpm. From the same amount of five grams of microalgae, lipid was extracted by bligh and dyer method with the usage of Chloroform: methanol at 2:1 ratio. Five grams of microalgae produced 0.25 g of bio-ethanol (5 %) and 0.33 g of lipid (6.6%). Considering the energy input given for each procedure, the net energy value of bio-ethanol significantly higher than the lipid extraction. Therefore, the lipid extraction should be considered as an effective method compared to bio-ethanol production from *chlorella vulgaris.*

Keywords: Alkaline pre-treatment, Bio-ethanol, *Chlorella vulgaris*, Lipid extraction

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Design and development of a coconut crust removing machine to support the Sri Lankan small and medium enterprises (SME) for the production of white coconut oil and shredded coconut

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Abstract

Coconut can be introduced as a plant having a higher value agriculturally, economically and consider as one of the main exporting items that support the Sri Lankan Gross Domestic Product (GDP). According to the 2019 Central Bank report, Sri Lanka has exported coconut production about 3085.6 million nuts and the contribution for the GDP is 0.7%. These data show that Sri Lanka is growing its income from exporting coconut-based products. The research aims to develop a machine mainly targeting the production of white coconut oil and shredded coconut, especially for biscuits and chocolate. The machine can be utilized to replace the labour involved in unsafe methods to remove the coconut crust in the process while increasing the production rate. As per the observations, even skilled people get injured because of the hand-operated peeling practice. The developing machine is capable of removing the crust on the outside of the coconut and copra in 20-30 seconds. The main benefit of the developing machine is, parallel ten coconuts can be peeled (at the end of the development) and that will increase the production rate of the process and the profit. Further, the other objectives of the research develop an affordable and ergonomically suited machine to ensure the safety of the operators, easiness of maintenance and adoption of the process, and reduction of wastage. Not only that, the expected payback period of the machine is lesser than 1.5 years. So far, the prototype is developing for one coconut and in the next step of the research, it is scheduled to extend for ten parallel coconuts and hand it over to a company for trial as a pilot project. The ultimate expectation is to contribute to the increment of local productivity of SME in the coconut industry while reducing human enrolment of high fatigue activities.

Keywords: Coconut crust removing, Ergonomics, Shredded coconut, SME, White coconut oil

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Agri-Business and Entrepreneurship

Oral Presentations

Entrepreneurial orientation and farm business performance: A case of Cinnamon farmers in Galle district

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Abstract

Ceylon cinnamon grown and produced in Sri Lanka has acquired a long-standing reputation in the international market. As the fourth largest foreign exchange earner cinnamon plays a significant role in the Sri Lankan economy. Sri Lanka holds a monopoly in Ceylon cinnamon in the world market. Hence, Ceylon cinnamon has opened undisputed windows of opportunity for value chain actors including farmers to display entrepreneurial spirit. However, cinnamon farmers are not equipped to exploit this opportunity due to poor entrepreneurial orientation (EO). This study aims to empirically examine the influence of EO on farm business performance, moderating role of farm and farmer characteristics, and on-farm and off-farm diversification to the EO- performance relationship. Galle district was selected for the study due to the district being the country's main cinnamon producing area. Primary and secondary data were used, and interviewer-administrated questionnaires and structured interviews were used as data collection tools. The sample comprised of 100 cinnamon farmers selected by using a stratified sampling technique. The data were analyzed using descriptive statistics and structural equation modeling technique. Results revealed that entrepreneurially oriented farmers achieved better financial performance. However, entrepreneurial orientation did not contribute to non-financial performance aspects of farm operation. Farm and farmer characteristics did not moderate the EO-performance relationship. Further, farmers who engage in on-farm and off-farm diversification activities did not contribute to enhance business performance. Entrepreneurially oriented farmers with better farm and farmer characteristics along with engagement in on-farm and off-farm diversification practices paid less attention to cinnamon cultivation due to lack of time. This has led to failure of achieving better business performance.

Keywords: Entrepreneurial orientation, Farm and farmer characteristics, Financial performance, Non-financial performance, On-farm and off-farm diversification

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Farmers' willingness to pay for water quality improvements: A case of small tanks in Anuradhapura District of Sri Lanka

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Abstract

Natural water resources, particularly the tanks play a significant role in the livelihood of the farmer households in the Anuradhapura district. Over the years, these tanks have been abandoned due to pollution and other socioeconomic and political activities leading to a lack of access to adequate quality water supply. Inadequate estimation of tanks' true value as a multipurpose resource is the key reason behind poor management. Therefore, the study aims to elicit the willingness to pay for water quality improvements of the tanks in the Anuradhapura area. Data were collected from a sample of randomly selected farmer households living adjacent to small tanks. A choice experiment was used to elicit the willingness to pay and the preferences for tank quality improvement. Results revealed that respondents are willing to pay 10% of monthly income generated from tank related activities as a payment for quality improvement. The study also demonstrates that the level of water quality improvements has a significant positive impact on people's willingness to pay while the reduction of fertilizer level, fine and the payment do not have a significant impact. About 85 % of the respondents are willing to pay LKR. 100 as the service charge for tank water quality improvement mainly as they believe tank management to be their responsibility as a community. Study highlights the importance and community contribution for small tank rehabilitation programs in the Anuradhapura District.

Keywords: Choice experiment, Small tanks, Water quality, Willingness to pay

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Willingness to pay for improved indoor air quality: A contingent valuation approach

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Abstract

Household indoor air pollution has become an important environmental issue in both urban and rural households that calls for proper economic valuation. Air pollution, both indoor and outdoor is increasingly becoming a threat to human health in most developing countries where Sri Lanka is no exception. Therefore, this study employs a contingent valuation approach to investigate the factors influencing residents' willingness to pay for improved household indoor air quality. Data were collected using a structured questionnaire from a sample selected based on a cluster sampling from households in the Colombo District. Data were analyzed using a Probit model to estimate the determinants of indoor air quality and the respondents' willingness to pay. Results revealed that 78% of respondents were willing to pay for improved household air quality, while other 22.5% who were not willing to pay claimed that it is the government's responsibility to maintain air quality. These non-payers also believe that the polluter should pay for the damage. Probit model revealed that monthly household income and respondent's education level significantly influenced their willingness to pay. Where the impact of gender is concerned, men, particularly the older ones were willing to pay more for air quality improvement than females of the same age group. A large proportion of respondents were willing to pay for improved air quality which signals that the awareness regarding the environmental issues of residents in these districts are high. This study also sheds light on the importance of prompt action to address household indoor air pollution suggesting prioritizing environmental controls to mitigate indoor air pollution in urban areas of Sri Lanka.

Keywords: Air pollution, Contingent valuation method, Probit model, Willingness to pay

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Market orientation of up-country and low-country vegetable farmers in Sri Lanka

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Abstract

Vegetable farming is one of the most important sub-sectors in Sri Lankan economy. Based on the agro-ecological adaptability, vegetables grown in Sri Lanka are broadly divided as up-country vegetables and low-country vegetables. The issues in the agricultural marketing system could be influenced by vegetable farmers' level of market orientation. Consequently, the study aimed to identify the level of market orientation of up-country and low-country vegetable farmers and to ascertain whether there is a difference in market orientation between these two farmer groups. The level of farmers' market orientation was determined using 'MKTOR' scale proposed by Naver and Slater (1990) which includes customer orientation (concern on customer preferences, well-being etc.), competitor orientation (concerns on neighbor-farmers' activities) and inter-functional co-ordination (relationships with other stakeholders) as behavioral components. In order to include a monetary sense to the scale, additionally, farmer's profit orientation (concern on prices and margins) was also incorporated. Using cluster sampling technique, sub-samples were selected for the study and individual respondents were selected using simple random sampling. Accordingly, 355 up-country vegetable farmers and 645 low-country vegetable farmers were selected from different locations in the Country. Primary data were collected through a field survey by administering a structured questionnaire. Data were analyzed using descriptive statistics and outliers were removed to reduce the variability in data. Consequently, three categories were generated within each sample as vegetable farmers with low market orientation, moderate market orientation and high market orientation, after adding and deducting standard deviations from the mean values. The results indicated that in both up-country and low-country contexts, majority of the farmers (61.4% and 63.6% respectively) are moderately market oriented. The second highest majority (26.8%) in up-country vegetable farming shows higher market orientation, whereas in low-country vegetable farming, the second highest majority (23.8%) were less market orientated. Nevertheless, a significant mean difference could not be identified between two samples. Thus, it is concluded that up-country vegetable farmers tend to be relatively more market-oriented, yet, they cannot make a significant difference in the agriculture marketing system in Sri Lanka. Hence, the strategies to enhance market orientation should target all vegetable farmers in the country.

Keywords: Low-country vegetable farmers, Market orientation, Up-country vegetable farmers

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Factors associated with purchasing intention for safe vegetables in Kesbewa Divisional Secretariat Division

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Abstract

In modern Sri Lankan context safety of the food has become a major role in the society because there were many food poisoning cases. In most of the time vegetables in the market have contaminated with many synthetic materials like pesticides. Since the vegetables are growing only in certain areas of the country, vegetable have to transport directly to the main economic centers and then distributed for other retailers. In the present context, customers are highly concern on purchasing safe vegetables, if they are available in the market. Anyhow, the purchasing intension of vegetable is varied in each customer depending on many factors. Therefore, this research was conducted to analyze the factors affecting on purchasing intention of safe vegetables in *Piliyandala* city area by using theory of planned behavior and give suggestions to the interested parties such as vegetable vendors in the area to make better performances. *Piliyandala* city area was selected as study location concerning its location as semi urbanized area belongs to the *Kesbewa* DS division and representation of multi ethnic groups. The research model is consisting with dependent variable, purchasing intention and four independent variables namely health consciousness, attitude towards safe vegetables, subjective norms and perceived behavioral control. Data collection has been done by five-point Likert scale questionnaires from 110 residents in Piliyandala and analyzed by using SPSS 25.0 software. The main conclusions have taken from descriptive, frequency, regression and factor analysis. However, the findings indicated that out of four factors health consciousness, subjective norms and perceived behavioral control have shown a positive impact on purchasing intention towards safe vegetables. Perceived behavioral control showed the highest impact towards purchasing intention. This study is significant to guide the farmers, producers and retailers to implement better marketing approaches focus on consumer behavior as well as consumers to persuade towards purchasing safe vegetables. Policy makers including government should focus on aware the people and promote safety concern in vegetables in the market since food safety is critical topic in the society now a days.

Keywords: Purchasing intention, Safe vegetables, Theory of planned behavior

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Role of NGO on livelihood development and gender mainstreaming; A case of mushroom value chain

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Abstract

This research intends to explore the facilitation role of NGO in rural livelihood development and to measure the outcomes of livelihood development opportunities. Household food and nutrition security, income generation, employment opportunities, space for women, human resource development, market opportunities and wellbeing created by a local NGO through initialization of mushroom farming. Primary data collection tools were structured pre-tested questionnaire, two in-depth interviews with key informants, and participatory mapping. A Sample of 87 both funded and non-funded mushroom farmers was selected through simple random sampling technique from Hambantota district. The sample included 61 female farmers of three categories low income, disabled and female headed. Data analysis techniques included descriptive statistics and paired sample t-test. Facilitation role of NGO can be categorized into to two main sections; provision of tangible and intangible assets. Financial capital for initiation of mushroom cultivation and develop necessary facilities help to empower resource poor families. Training on mushroom production, packing, processing and record keeping strengthen the human capital of the low income, disabled and female headed households. Facilitation on business registration, continuous monitoring and evaluation of the process and establish community plus local institutional network ensure the sustainability of the venture. Results revealed that funded female farmers have enhanced their household wellbeing, nutrition security, open up employment opportunities for the housewives, strengthened women participation in family income generation and link farmers into markets. Further, venture creation improves household economic status, enables their savings culture in both formal and informal ways, and generated investment opportunities. Further, COVID-19 pandemic badly affected on most vulnerable rural livelihoods but NGO assisted farmer groups were able to manage the situation positively compared to non- supported farmers.

Keywords: Livelihood development, Mushroom farmers, NGO

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Developing an index to evaluate tea estate performance in up-country region of Sri Lanka

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Abstract

Sri Lanka is the fourth-largest tea producer in the world. In the Sri Lankan economy, tea plays a key role contributing 2% to the GDP and foreign exchange earnings. The tea industry consists of large-scale estates managed by Regional Plantation Companies (RPC) and tea small-holders. The tea industry's contribution to the country's economy is said to be flawed. Among many problems the industry faces, there is a significant variation among the estate performances even under the same management. Also, very limited research studies have been conducted to evaluate the performance of tea estate in Sri Lanka. Thus, this study aimed at developing a performance index to evaluate the performance of selected tea estates in the upcountry region of Sri Lanka. It further investigated the factors associated with the enhancement of the performance of estates. An analytical and descriptive type study focusing on the qualitative approach were conducted with an open-ended and interview-type questionnaire combining the quantitative method. Eleven variables were identified as the most important in performance evaluation through direct interviews with five plantation experts selected purposely. Using the selected variable and the weighted values assigned for each variable an index was formulated as *Tea Estate Performance Index* (TEPI). Five-year average data (2013-2018) of each variable for all seven estates were collected and the average values were calculated. The values were normalized to take them into the same scale. Results show that Estate "1" has shown an excellent performance in labour out turn (V5), percentage of made tea out-turn (V6), percentage of main grades (V7), and cost of production (V10). Even though, the estate has done fairly good in many variables, the percentage of vegetatively propagated plants (V1), plucker intake in the estate (V3), and output per factory worker (V9) showed low values. The Estate "2" has shown good performances according to the percentage of vegetative propagation of plants (V1) and percentage of labour out turn (V5), it has poor performance in the percentage of made tea out turn (V6), percentage of main grades (V7), output per factory worker (V9), cost of production (V10) and profit per ha (V11). Considering all the variables, it is observed that Estate "1" has ranked number one in selected sample, the Estate "2" has ranked seven in the upcountry region. In conclusion, proposed index can be used to evaluate and compare the performance of tea estates and the management can take strategic management decisions accordingly to improve estate productivity.

Keywords: Labour productivity, Performance Index, Plantations, Profitability, Tea estates

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Entrepreneurial competencies and performance of mushroom producers in Kamburupitiya GN division

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Abstract

The entrepreneurs must act proactively with the environment in order to diminish the negative consequence of the challenging business environment. Entrepreneurial competencies are becoming more important to take such a proactive move towards the environment. Hence, this study's aims were; to examine the relationship between owner's background characteristics and entrepreneurial competencies and to analyze the impact of entrepreneurial competencies on performance. Primary data were collected from randomly selected 45 mushroom producers (owners) in the *Kamburupitiya* DS Division through a field survey using a pretested structured questionnaire. Entrepreneurial competencies were operationalized as an opportunity, organizing, strategic, relationship, commitment and conceptual competencies. Data were analyzed using descriptive statistics, Pearson correlation and regression analysis. Results revealed that, 71.7% of the owners were studied up to G.C.E. Ordinary Level. Further, 32.6% of owners have participated in training sessions before starting their business whereas 67.4% of owners have such training after starting up their mushroom businesses. Regression analysis revealed that there is a significant positive relationship between educational level and the opportunity competency level of respondents (β=.642, $p<0.1$). Results of the correlation analysis shown that opportunity ($r= 0.71$, $p<0.01$), relationship ($r=0.37$, $p<0.05$), conceptual ($r=0.46$, $p<0.01$), organizing ($r=0.31$, $p<0.05$) and strategic competencies ($r=0.76$, $p<0.01$) were positively and significantly effect on the business performance. Further, regression analysis implied that owners' strategic and opportunity competencies have a direct positive relationship with mushroom production's business performance in the *Kamburupitiya* DS Division. Accordingly, this study concluded that the strategic and opportunity competency levels of entrepreneurs are important to enhance the performance of mushroom production like cottage industries.

Keywords: Background characteristics, Entrepreneurial competencies, Mushroom industry, Performance of cottage industries

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Economic analysis of small holder paddy farmer's irrigation problems in Kalutara district

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Abstract

Being the staple food of the country, Sri Lanka maintains high level of self-sufficiency in paddy production. To achieve higher productivity and production levels, paddy cultivation requires adequate irrigation supply particularly at critical stages of the crop. This study explores the major irrigation issues on small holder paddy cultivation in Kalutara district. Primary data were collected through personal interviews with randomly selected hundred paddy farmers from Mathugama and Agalawatta divisional secretariat divisions in Kalutara district. Descriptive statistics, Correlation analysis and chi- square analysis were used in data analysis. The results revealed that 40% of farmers were educated up to secondary level, while 10% up to tertiary level. Only 45% of respondents cultivate paddy on their own lands. Seventy one percent of farmers have the access to assured source of water for paddy cultivation both in Maha and Yala seasons. In Maha season, 72% of respondents used rainwater as their main water source for cultivation and 18% used water from external sources like canal irrigation, while 10% used both. Only 16% of farmers solely depend on rainwater in dry Yala season while a large majority of respondents (61%) used external water sources. Results of correlation analysis between contaminated irrigation water and income of farmers in Maha season showed statistically significant negative linear relationship ($p<0.05$). The study revealed that, increased water contamination causes a significant loss in farmer's income in Maha season may be due to flow of polluted water by the industrial wastes into the paddy lands during monsoon period. Study further revealed that, floods in Maha season, contamination of irrigation water with industrial wastes, drought and yield losses in Yala season and issues with irrigation canals were the major factors affecting the seasonal income from paddy cultivation. The lower yields particularly in Yala seasons can be attributed to the poor condition and other water conveyance issues associated with the irrigation canals used by most paddy farmers. The paddy yield levels, and production can be further increased by improving the operation and maintenance of existing irrigation canal systems and further expansion of these canals in the study area.

Keywords: Contamination, Irrigation problems, Small holder paddy farmers

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Poster Presentations

The impact of household income on dried fish consumption in Sri Lanka

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Abstract

Dried fish plays an important role in human nutrition in Sri Lanka by supplying more than 60% of the total animal protein intake for the populace. Despite of the high consumption of fish and chicken, dried fish remains at the third place against the increasing prices. Dried fish prices have increased drastically from 2012 in compared to fish and chicken prices where the later remains relatively constant during the period. The consumption and expenditure patterns of chicken, fish and dried fish (the main animal protein sources except egg and dairy) differ in relation to the mean income of respective expenditure deciles; a categorization of socioeconomic status by dividing the population into 10 income groups from the lowest income (1) to the highest income group (10) based on the expenditure pattern. This study explores the relationship between the level of dried fish consumption and expenditure over mean income of each expenditure deciles. A quantitative approach was followed drawing secondary data from Department of Census & Statistics and Ministry of Fisheries and Aquatic Resource Development and Hector Kobbakaduwa Agrarian Research and Training Institute (HARTI). Monthly average household consumption quantity (g) and expenditure (Rs.) of commonly used dried fish varieties [skipjack tuna (*Katsuwonus pelamis*) and dried sprat (*Stolephorus sp*.)], fresh marine fish varieties [skipjack tuna and yellowfin tuna (*Thunnus albacares*)], and chicken were considered for the analysis during 2006-2016. Pearson correlation coefficient and income elasticity analyses were adopted using SPSS 21. Higher percentage share (36% <) of dried fish expenditure is captured by 1-4 income range of expenditure deciles that counts on 1-3 for consumption (43% <). In contrast, chicken is highly consumed (39% <) at higher income households (4-10). Results reveals that the analyzed dried fish varieties, which are highly consumed in Sri Lanka bears lower income elasticity of demand, which is (Sprats-0.55 and Skipjack tuna-0.56) less than 01 while chicken shows 1.06. A strong positive correlation between percentage share of chicken consumption (0.777)/ expenditure (0.802) while negative correlation with percentage share of dried sprats (-0.743)/ dried skipjack tuna (-0.798) consumption are observed against mean income in each expenditure deciles. In conclusion, the dried fish act as the main animal protein source for lower income while chicken serves for the higher income households. Income elasticity of demand indicates all observed varieties as normal goods except chicken, which are luxury goods. Therefore, decisions and policies on pricing and marketing of dried fish need to be addressed in favor of the lower income population in the country whose nutritional security highly depends on dried fish consumption, as an animal protein and micro nutrient sources.

Keywords: Consumption, Dried fish, Expenditure deciles, Income elasticity of demand

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Venture performance and diversifications on household wellbeing: A case of dairy farming households in Hingurakgoda DS division

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Abstract

This research intends to measure the performance level of both dairy ventures funded by Sri-Lanka Centre for Development Facilitation (SLCDF) and non-funded dairy ventures of Hingurakgoda DS division. Objectives of the study was to explore the product, process, marketing and management diversifications adopted by the dairy ventures and to measure the level of diversification of both funded and non-funded dairy ventures, and to find out the performance of dairy ventures and the impact of diversification on household wellbeing of dairy farming households. Survey strategy was utilized as the principal data collection tool and both qualitative and quantitative techniques were used. A sample of 100 dairy farmers were collected from Hingurakgoda DS division including 50 SLCDF (NGO) funded farmers and 50 of non-funded farmers using simple random sampling technique. According to the study four categories of diversification; product, process, market and management were explored. Product diversifications identified were mainly curd, pudding, yoghurt and milk toffee. Market diversification available in the farmer base was identified as owning a milk collection center. Record keeping was identified as common management diversification. Process diversification included artificial insemination (80%) for cattle breeding, silage making (10%), owning a silage cutter (8%) and grass cutters (5%) and preparing mixed rations (1%). Results revealed that the level of diversification of the funded farmers (0.42 out of 1) was higher compared to non-funded farmers (0.34 out of 1). Both male (0.72 out of 1) and female dairy farmers (0.71 out of 1) were operating and performing equally. Venture performance was measured with dimensions efficiency (Return on Investment, Benefit Cost Ratio, and profitability), responsiveness, quality, flexibility, reliability, product availability. There was no significant difference between the overall venture performance level of the funded farmers (0.71 out of 1) and non-funded farmers (0.72 out of 1). But the ROI (Return on Investment) of funded farmers (158.65), product quality and reliability were higher compared to non-funded farmers (111.39). The performance of dairy ventures and diversification had an effect on household wellbeing of dairy farming households in Hingurakgoda DS division. Accordingly, the highly performing ventures with high level of diversification had improved savings, monthly income and bank loan repayment ability in their families. It can be concluded that dairy venture performance has an impact on the household wellbeing of the farmers and product diversification had also contributed to the household wellbeing of the dairy farmers.

Keywords: Diversification, Household wellbeing, Venture performance

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Successfulness of rural innovative micro and small enterprises: A case in Pambahinna area

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Abstract

The level of success of an innovative entrepreneur who creates income generating Micro and Small Enterprises (MSEs) can be measured using eight dimensions; quality of the products and services, consumer satisfaction, owner satisfaction, social recognition, capacity utilization, profitability of the business, diversification and product recognition. This study focused to assess entrepreneurial success level (ESI) of MSEs who serve the needs and wants of a temporary resided university community. A sample of 47 MSEs was selected through the snowball sampling technique from Pambahinna area who serve the residencies of Sabaragamuwa University. Interviewer administrated and pre-tested questionnaire was used in the collection of primary data on the socio-economic status, business operations, dimensions of ESI, and discussions. Descriptive analysis, index calculation and SWOT analysis were adapted in the data analysis. Most of the MSE owners were females (68%) around the age group of 31 to 40 years (45%). The SME was the key income source of the majority (83%) which conducted mainly as a sole-proprietorship (92%). Forty percent (40%) earned an income over 60,000.00LKR per month from a range of industry types (food: 62%, grocery stores: 11% beauty parlor: 11% communications: 9% tailor shop: 6%, hardware store: 2%) from enterprises of two to 10 years of age (46%). Entrepreneurial Successful Levels (ESL) were very high in 32% enterprises while high in 43% enterprises as MSEs. As the respondents indicated, they as MSEs who serve the diverse needs and wants of temporarily residing university community were considerably successful with their own sole-proprietors. However, the lag periods of the resided community especially due to current pandemic situation most the MSEs faced difficulties in continuing the same level of the profitability and majority have left the business due to post-covid business failure. Therefore, MSEs needed to be strengthened to serve not only for a temporary residing community but also to inter-link with other possible buyers and to be diversified their business operations to serve a constant consumer group.

Keywords: Micro-small enterprises, Entrepreneur, Entrepreneurial success index, Rural development

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Impact of herbicide usage on paddy productivity- A study in the Gampaha district

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Abstract

As the Rice being the staple food of Sri Lankans, paddy cultivation is one of the main agricultural activities in Sri Lanka. Therefore, agrochemical usage is increasing despite of the paddy production nearing a plateau. In this context, the aim of this research are to investigate the impact of herbicide usage and awareness level on paddy productivity. Data was collected by surveying 100 farmers adopting a stratified random sampling method. The Yala season data encompassing the period from May to August in 2020 was recorded. The stochastic frontier model was employed to determine the productivity. The Frontier 4.1 software was used to estimate the parameters. To investigate the awareness level of the farmers regarding herbicide usage, an index was developed based on a Likert scale questionnaire. With the result of the awareness index, multiple linear regressions were used to estimate the effect of farmer awareness level on health and environmental implications on paddy output. According to the results of the estimation, herbicide cost did not show any statistical significant impact on paddy productivity. The farming extent is positively significant and the family labor is negatively significant among the other variables. The mean technical efficiency is 76% implying farmers are still away from their technological frontier by 24%. The herbicide cost is significant at 1% level in the cost function. According to the awareness index, all the farmers have a high awareness level. However, according to the multiple regressions results, awareness level has no impact on the paddy yield. These results imply that herbicide usage and the farmer awareness level on health and environmental issues has no impact on paddy productivity in the Gampaha district. As farmers show high level of awareness it can be leveraged to motivate them to adopt sustainable farming practices. This could help to reduce the cost of production and preserve the environment

Keywords: Awareness level, Cost function, Production function, Stochastic frontier model, Technical efficiency

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The role of quality standards and certifications to uplift the export fresh fruits sector in Sri Lanka

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Abstract

Sri Lanka produces around one million nineteen thousand metric tons of fruits annually, and the contribution of fruits to export market is indeed unsatisfactory because it contributes only 0.04% of the total world exports. Moreover, Sri Lanka exports to limited destinations with difficulties in meeting the stringent safety and quality requirements of importing countries. Our research focus was to determine the role of quality standards and certifications in export-oriented fresh fruits sector. A total of 30 fresh fruits exporting value chains that have registered in Export Development Board (EDB) was selected based on Colombo, Gampaha, Kalutara, Monaragala, Anuradhapura, Kurunagala, Hambantota and Matale districts. Key informant interviews, focus group discussions, and interviewer-administered questionnaires were used to collect primary data. Exporters were selected from purposive techniques. Intermediates and farmers were selected by using the snowball sampling technique. Descriptive statistics, frequency, chai-square and relative important index were used as data analysis techniques. Results revealed that the majority of the Sri Lankan exporters use ISO 22000, HACCP and EU Organics and the majority of fruits exports more concentrate among the Middle East and Asian region while huge market opportunity is available in the EU market. In the fresh fruits exporting value chain, the awareness level of the upper stream is lower than the downstream. Intermediaries act as a barrier to adopting proper quality standards and certifications in the fresh fruits exporting sector in Sri Lanka. Less transparency in following proper quality standards and certifications requirements in the upper stream cause to limits the export market. Providing safety and quality standards and certification guidelines in local languages (Sinhala or Tamil) play a remarkable role to penetrate the knowledge level in the upper stream of the fresh fruits exporting sector. Further, marinating proper traceability and transparency throughout the fruits export value chain increases the trust in the global market at the exporter level.

Keywords: Certifications, Export, Fresh fruits, Quality standards, Sri Lanka

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Customer perception towards the family style restaurants: A study at Avissawella suburban area

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Abstract
Restaurant industry is a popular business avenue among the entrepreneurs who interested in initiating own livelihood business. Success of such business depends on the level satisfaction created by the products and services offered by the restaurant. The identification of customer preferences at a broader spectrum will enable to provide a better service to create satisfied loyal customers for a sustainable business operation. Therefore, current study focused to explain the factors affecting on customer perception towards family style restaurants in Avissawella suburban area. Total sixteen variables related to the customer perception of suburban family style restaurants were identified through the literature review followed by the visual observations to relate the selected factors. A samples of 100 was selected via convenience sampling technique. Interviewer administrated structured questionnaire strategy was adapted in data collection. Factor Analysis, nonparametric correlation and descriptive statistics were used in data analysis. The sixteen variables which were tested for their validity and reliability to conduct the Principle Component Analysis (PCA) (KMO value=0.772 and Cronbach's alpha=0.835). According to the key findings, the age category 18 to 25 years (43.0%) recorded to be the major dining group at family style restaurants as this group include students who enjoy outdoor dining facilities as food lovers and socialize among their friend circle. As most of the respondents were unemployed students' category (41%) and included in economically dependent category (39%), causing them to select family style restaurants to dine with their colleagues or parents as they provide economically feasible pleasant environment to dine quality food with good service. Among the respondents, majority (45%) liked to dine at family style restaurants because of the good taste of food. Other to celebrate special occasions (25%) and because of the others recommendations (18%). Results of Principle Component Analysis indicated that, consumers had placed their priorities on promotion and service (5.383), internal environment (1.561), brand reputation (1.333), and food quality (1.216) in choosing family style restaurants in suburban Sri Lanka which were correlated. As the family style restaurants were popular among the young adults who were still economically depending, by improving the quality of food and services, promotional activities, attractiveness of the dining environment will be enable to serve the customers at satisfactory level.

Keywords: Customer selection, Factor analysis, Family style restaurants, Suburban

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The impact of individual awareness, attitude & practices on household food safety: A study in Kegalle district

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Abstract

Strengthening food safety in household level is a major concern in today's world. It is arguing that, having an awareness, attitudes on food safety and better hygienic food practices followed by the individual households are important for the healthy life style, as it is directly affecting on the incidences of many diseases prevalent in the society. Therefore, this study aimed to examine the impact of individual awareness, attitude and practices on household food safety by focusing on the Kegalle district. To achieve this objective a quantitative study was undertaken by employing both descriptive and inferential statistics using a household survey. A sample of 90 households were taken from three divisional secretariat divisions in Kegalle district. Data was collected through well-structured questionnaire and analyzed using correlation and regression analysis. Reliability analysis was conducted to measure the validity of the instrument. The descriptive results have shown that response was in a satisfactory level related to awareness (mean of 5.1), attitudes (mean of 4.6) and practices (mean of 5.1). According to the regression results, awareness and practices have significant relationships with the household food safety. However, attitude has not shown significant impact on household food safety. Overall, this study concludes that householders' awareness and practices have a significant impact on household food safety. Findings of this study will be useful for academics for the development of future works in the field of food safety.

Keywords: Attitude, Awareness, Practices, Household food safety, Kegalle district

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Impact of technical measures on fish and fishery products export in Sri Lanka

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Abstract

Sri Lankan seafood offers a variety of products to the international market contributing 2.2% to the Sri Lankan total merchandise exports. Non-tariff measures (NTMs) bring numerous difficulties to access to the international seafood market and the most of companies in the seafood industry have to encounter with these NTMs. This study aims to unravel the present status of technical measures applied on fish and fishery products export in Sri Lanka which would be useful for the seafood exporting companies with wider potentials. Out of seventy fish and fishery product exporting companies registered in the Department of Fisheries and Aquatic Resources (DFAR), 30 companies were selected using simple random sampling technique. Pre-tested questionnaire survey (n=30), key informant discussions (n=4) with the National Resources Research and Development Agency (NARA), the Ministry of Fisheries and Aquatic Resources Development (MFARD), and Export Development Board (EDB) officers were conducted for primary data collection. Secondary data were collected from reports and records of DFAR and EDB, research and survey reports published by NARA and MFARD and the international database as Trade map. Majorly Sri Lanka exports fish and fishery products to 15 countries. EU countries have imposed the highest frequency of technical measures on Sri Lanka and the second is USA while the highest frequency of technical measures are required for Tuna. Mostly required types of technical measures are health certificate (55%), ISO 22,000 (50%), histamine test (36%) and heavy metal test (32%). The average cost range for the procedural fee and the annual renew fee of certificates are 600,000 – 90,000 and 130,000 – 45,000 respectively while the average annual cost range for tests is 172,000 – 18,000. Pre-shipment Inspection (PSI) is done by import companies especially at harbours as weighing and checking labels. The main difficulty that exporters face is unaffordable high cost of certificates and tests. According to 98% of companies, the places to conduct tests are not enough and appropriate, therefore long queue and delaying to do tests decrease the profit margin. Although tariff barriers lessen due to free trade, NTMs hinder the export process specially shrink profit from western sea food market.

Keywords: Fish and fishery products export, Technical barriers for trade, Technical measures

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Attitude towards environment on green purchase behavior with the mediating effect of green purchase intention

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Abstract
This study was conducted to identify the impact of attitudes towards environment on green purchase behavior with the mediating effect of green purchase intention. Sample of the study was selected among the customer population of supermarkets in Sri Lanka. Convenient sampling technique was used to take a sample of 121 from the target population. Questionnaire based survey was conducted to gather data from the selected sample. Regression analyses was performed to analyze the gathered data. SPSS version 23 was used to analyze that data. The study found that attitude towards environment significantly influence green purchase intention (0.001, 9.7%). It also influenced consumers' green purchase behavior significantly (0.000, 15.9%). Green purchase intention also significantly influences the green purchase behavior (0.000, 42.5%). Green purchase intention significantly mediates the relationship between attitudes toward environment (0.003) and green purchase behavior (0.000). The results of this study found that 47% of Green purchase behavior was explained by these two factors; green purchase intention and attitudes toward environment. This study will attempt to enhance the green purchase behavior of customers through green purchase intention with attitudes toward environment.

Keywords: Attitudes towards environment, Green purchase behavior, Green purchase intention

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Employees' perception on their self-productivity in work from home during lockdown period

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Abstract

Governments across the world have enacted various social distancing policies in response to the global pandemic of COVID-19. Employers in different sectors have taken challenging decisions to minimize the congregation of people by taking an abrupt shift to work from home (WFH). In 1972, Jack Nilles introduced "Work from Home" as an employment arrangement where employees work outside the office, usually home or a location close to home. The current literature revealed that the feasibility of WFH for all occupations around the world. This paper further examined how these employees' socioeconomic characteristics influenced their perception on self-productivity during WFH. The survey data was collected using a google form from 150 employees using the Snow Ball Sampling method. The perception on self-productivity was evaluated using Five Point Likert Scale in view of workload completed and the time spent on completing a task during WFH. The comparative analysis conducted using descriptive statistic methods and the Chi-square test. The sample consists of 59% of females and 41% of males. Furthermore, the sample represents 21% of Government, 17% of Semi-government, and 62% of Private Sector employees. There is a significant difference between marital status and perception on self-productivity ($p = 0.003$, $\alpha<0.05$). Married employees manifested lower productivity due to matters related to home caregiving. Besides, this lower productivity is disproportionately affected by the presence of children. There is a significant difference between the presence of children with the time spent on completing a task ($p=0.031$, $\alpha<0.05$) and also with their perception on self-productivity ($p = 0 .003(\alpha<0.05)$. Thereby, employees having children demonstrated lower productivity than singles. The comprehended review suggested that lack of interaction with peers, absence of essential resources like computer devices, software, speed network connection, and absence of motivation have limited their capacity leading towards lower productivity during WFH. Moreover, 59% of employees prefer to continue WFH, and 27% have responded as indifferent, while 14% have stated their disfavor towards continuity of WFH even after the pandemic. This study in turn helps inform policy-makers to understand that working from home it-self has largely been beneficial if the main issues are being addressed accordingly.

Keywords: Perception on self-productivity, Social distancing, Socioeconomic, Work from home

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Corporate environmental performance disclosures in publicly listed companies of Sri Lanka

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Abstract

Corporate Environmental Performance Disclosure (CEPD) is the reporting of corporate information relating to a particular firms' interaction with the natural environment. Typically, the nature of reporting of CEPD may vary from one country to the other based on the stakeholder pressure and other requirements. In Sri Lanka, although some empirical research could be found, there is a significant dearth of descriptive research on nature and practice of CEPD. On this backdrop, this study examines the nature of CEPD of Sri Lankan firms. The annual reports of the top 25 companies, which includes both manufacturing and service-oriented firms, listed in the Colombo Stock Exchange with the highest market capitalization from 2015-2019 were selected for the study and the descriptive statistics were used to determine the nature of environmental disclosures. The results showed that a larger proportion of firms (80%) tend to report their environmental performance through their annual reports and that, forty-eight per cent (48%) of the firms' environmental disclosures have shown to include both quantifiable and descriptive information whereas 32% of the firms solely disclose their performance descriptively. The commonly identified quantifiable environment performance indicators in the disclosures include carbon footprint (44%), the energy consumption (32%) and water consumption (32%). Moreover, our analysis reveals that, the lowest numeric figures with regard to these indicators were reported by firms in the services sector. The most commonly reported indicator by the firms were carbon footprint information and the highest carbon footprint was reported by a diversified conglomerate. Thirty-six per cent (36%) of the top market capitalized companies have obtained environmental certification for their business processes while 40% of firms have disclosed their environmental performance through achievements and awards. This concluded that a larger number of Sri Lankan companies are engaged in environmental sustainability reporting considering the top market exposed companies in Sri Lanka and most of these firms disclose their environmental performance in terms of quantitative figures related to environmental indicators. The results provide insights to non-reporting companies on how the benchmarked firms in the industry perform and understand the general concepts to be included in their CEPD to minimize legitimacy issues and operational risks and enhance their firm reputation.

Keywords: Carbon footprint, Environmental reporting, Quantifiable environmental performance indicators

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Awareness and attitude of consumers on green products in Mapalana GN division, Matara, Sri Lanka

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Abstract

Current rapid economic growth and consumers' consumption pattern are the main root causes for the descent of the environment. With the environmental deterioration geared by the rapid population growth, the developing countries are recently concerning the green movement. Therefore, the present research contributes to the field by identifying the consumer awareness and attitude towards green products while evaluating the factors behind the consumers' attitude on green products. The study was conducted to the randomly selected 150 consumers from the 939 of Mapalana Grama Niladari (GN) division and the data were gathered through directing a pre-tested structured questionnaire survey. IBM SPSS version 25 was used as the principal analytical software and the data were analyzed descriptively as well as using inferential analytical tools such as the Independent sample t-test. The study revealed that there was a significant gender difference ($t=2.896$, $p=0.004$) in willingness to pay a premium price for environmental-friendly green products in order to conserve the environment. Comparatively females ($M=3.18$, $SD=1.156$) agreed to pay more than their male counterparts in this regard ($M=2.68$, $SD=0.937$). However, there was no statistically significant gender difference in respondents' awareness of the benefits of green products for their health ($t=0.962$, $p=0.338$) and for the environment ($t=1.603$, $p=0.111$). Moreover, there was no significant gender difference in knowledge on the ability of green products to decline the health risk ($t=1.223$, $p=0.223$) and in the level of awareness of green products towards the quality enhancements of the environment ($t=1.640$, $p=0.103$). Furthermore, the gender of the respondents was insignificant in concerning the government's responsibility in promoting manufacturing green products ($t=-0.198$, $p=0.844$). According to the Multiple linear regression, the income ($\beta=-0.157$, $p=0.007$) and the education level ($\beta=-0.360$, $p=0.000$) of the respondents have shown a significant negative contribution while the respondents' age ($p=0.338$), occupation ($p=0.526$) and civil status ($p=0.408$) have not significantly contributed to the consumers' attitudes on the green product. Hence, the research findings will be a key driver for policymakers in the agribusiness sector to promote environmental-friendly green products while considering gender and other significant attributes in particular.

Keywords: Attitudes, Awareness, Green products

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Crop Production Technologies

Keynote speech

Investigations of important tropical and sub-tropical underutilized plants for food and medicine: An approach towards future sustainable agriculture and environment

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Abstract

The keynote describes the potentiality of some of the selected underutilized plants genetic resources of the tropical and subtropical countries for providing alternative sources of food and nutrition for human and animal. These are also called as lesser known plants/neglected and underutilized plant species/minor crops etc. Magnitude of cultivable lands has been declining due to increased urbanization and industrialization, and rapidly growing population in some tropical and subtropical regions, and that pose challenges to further exploitation of major crops especially in Bangladesh. Minor crops, in such scenario, can play pivotal role in providing supplemental sources of food and nutrition security to the growing population in such countries. Further, minor crops including herbs, shrubs and trees are blessed with a multitude of merits. Most of such plants can be grown in the homestead, roadside, fallow lands and other unutilized public places, hence they would not compete with lands occupied by major crops *viz*., rice, wheat, maize and others. Further, usually underutilized plants confer better tolerance to abiotic and biotic stresses, and hence, good harvest can be obtained even with little care and poor soil fertility. Most importantly, a number of minor crops show increased adaptation to high temperature and salinity intrusion, and these attributes help adapt to climate change scenario that are prevalent in many tropical and subtropical countries. Investigations of such plants would, thus, have a greater impact on resilience and sustainability in Agriculture. In the current investigation, some key cultivation protocol, basic nutritional status and phytochemicals of health benefit in some selected minor plants are presented. The following crops are alternative sources of starch, protein, minerals & vitamins, antioxidants and beverages. Cassava (*Manihot esculenta*, Euphorbiaceae) is a starch yielding alternative to rice; pigeonpea (*Cajanus cajan*, Fabaceae) and beans (*Dipgon lignosus*, Fabaceae) substitute to animal protein; moringa (*Moringa oleifera* & *M. stenopetala,* Moringaceae) tree and sweet potato (*Ipomea batatus*, Convolvulaceae) are alternative sources of minerals, vitamins and phytochemicals of medicinal importance; foliage of beans, moringa and sweet potato are alternative sources of feed; and roselle (*Hibiscus sabdariffa* var. sabdariffa) calyx alternative to conventional beverage. In the current research, potentiality of these plants commonly found in tropical and subtropical regions as substitutes and cheaper sources of food (starch, proteins & vegetables), feed, beverage and medicine is highlighted.

Keywords: Alternative Food Sources, Minor Crops, Tropic & Subtropics

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Oral Presentations

The combination effect of *Salvinia molesta* and Cocopeat on growth and yield of Tomato (*Lycopersicon esculentum*)

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Abstract

Salvinia molesta (Salvinia) is an invasive aquatic weed with dimorphous leaves. This species has the capacity to cover the surface of even large bodies of standing and slow-moving water, forming a dense, continuous mat that preclude light penetration resulting in decreases in dissolved oxygen and pH, and increases in concentrations of CO_2 and H_2S. Dried form of Salvinia can be possibly incorporated into cocopeat media as a coarser material and a good nutrient supplement source. Therefore, this study was conducted to assess the impact of coarser material (dried form of Salvinia) in to cocopeat media to enhance the physical and chemical attributes of the medium and to evaluate the vegetative growth and yield of *Lycopersicon esculentum*. Three different combinations of dried Salvinia and cocopeat: (w/w) 90% cocopeat + 10% Salvinia (T1), 80% cocopeat + 20% Salvinia (T2), 70% cocopeat + 30% Salvinia (T3) were evaluated with available cocopeat media as the control (T4). Plant vegetative and reproductive parameters (plant height, number of leaves, number of branches, leaf area, root volume, dry weight of shoots, number of flowers, number of fruits, and yield) with bulk density, pH and Electrical Conductivity (EC) were obtained. The overall highest plant performance with significantly ($p=0.005$) highest yield was recorded in T3 which had suitable pH (6.4), EC (0.0161 dS/m). Significantly ($p=0.005$) lowest yield was recorded in the control. Vegetative growth and yield data confirmed the potential of incorporating dried Salvinia as a coarser material and a nutrient supplement in manufacturing of cocopeat grow bags. Further, this will be an effective and efficient tool of controlling the invasive *Salvinia molesta*.

Keywords: Aquatic weed, Cocopeat, Grow bag, *Lycopersicon esculentum, Salvinia molesta*

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Induced Defense enzymes in Chilli against *Chilli Veinal Mottle Mosaic Virus* by application of three selected plant extracts

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Abstract

Plants have their own defense activity against pathogen infection. This can be induced by application of both biotic and abiotic inducers. Antiviral compounds present in some plants act as inducers of defense enzymes in plants against pathogens. The study was carried out to determine the induced defense enzymes by application of plant extracts in chilli against *Chilli Veinal Mottle Mosaic virus* (CVMMV). A pot trial was carried out to find the induced defense enzymes. Leaves of *Bougainvilla spetabillis*, *Datura metal*, and *Mirabilis jalapa* were used for this study. Three methods of application viz, seed treatment, foliar spraying, and seed treatment with foliar spraying were used. Peroxidase, polyphenol oxidase, and phenol contents were determined after the treatment. The highest peroxidase and polyphenol oxidase enzyme activity was recorded in the application of *Bougainvilla spetabillis* in all application methods. Application of *Datura metal* showed the highest phenol content. Seed treatment with foliar spraying showed higher polyphenol oxidase enzyme activity than the other two method of applications in all plant extracts tested. Higher phenol content was observed in the foliar spraying application method. Application of all plant extracts tested induced the defense enzyme activity of chilli against CVMMV.

Keywords: Defense enzyme, Peroxidase, Phenol, Plant extract, Polyphenol oxidase

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Influence of integrated plant nutrient management using "Newly Modified Panchagavya" and "Albert Solution" on growth and yield parameters of *Capsicum annuum* (Variety - Muria 358 F1) under polytunnel cultivation

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Abstract

Excessive use of chemical fertilizers causes many environmental, social, and health problems. It is possible to avoid adverse conditions by using organic fertilizers but there are some shortcomings in providing the plant with the required nutrients using only organic fertilizers. Therefore, the integration of chemical fertilizers with organic fertilizers is one of the most applicable methods identified. 'Panchagavya' is a blend of five products (milk (107.5 mL/L), dung (250 g/L), urine (250 mL/L), ghee (35.5 g/L) and curd (71.25 mL/L)) obtained from a cow which act 75% as a fertilizer and 25% as a pesticide. In this experiment, the ordinary used 'Panchagavya' mixture was slightly modified by adding dry yeast as a fermenting agent and nutrient source which accelerate the fermentation process and pre trials were conducted to select the suitable concentration. Thus, this study was designed to identify an integrated plant nutrient management system for *Capsicum annuum* variety Muria-358 F1 cultivation in polytunnel by adding "Newly Modified Panchagavya" (NMP) as the organic fertilizer and commercially available Albert solution as a chemical fertilizer. The experiment was conducted in the polytunnel in Banadarawela from February 2019 to May 2019. Completely Randomized Design (CRD) was used with three replicates. Each replicate consisted of 6 plants and water (Control- T1), 3% NMP (T2), 5% NMP (T3), Albert solution (T4) and 50% of 3% NMP + 50% of Albert solution (T5) applied as treatments. According to the study, significantly ($P<0.05$) the highest average plant height in five weeks after planting, average stem diameter in six and seven weeks after planting, fresh and dry weight of roots and yield were recorded from the plants treated T4compared to the other treatments except treated T5. There was no significant difference between T4 and T5and T5. Further, the highest chlorophyll content and number of lateral branches per plant was recorded from the plant treated with T5 at the flowering stage of plants. The results revealed that the application of 50% of 3% NMP + 50% of Albert solution is an eco-friendly integrated nutrient management system for *C. annum* cultivation in polytunnel which is reducing 50% of chemical fertilizers.

Keywords: Albert solution, *Capsicum annum*, Integrated nutrient management, Panchagayva

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Chlorophyll fluorescence transient analysis to probe photosynthesis performance of three *Plectranthus scutellarioides* (L.) R.Br (Coleus) varieties under two contrasting light conditions

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Abstract

Chlorophyll fluorescence transient measurement has proved a strong technique to investigate the photosynthesis functions and integrated measurement to identify the stress responses. This technique uses the energy flux theory in the photosynthesis apparatus. *Plectranthus scutellarioides* (L.) R.Br (coleus) is famous as a landscape plant and the appearance of this plant is determined by environmental factors, especially by light intensity. An experiment was conducted to assess the influence of two contrasting light conditions on photosynthesis activities of three *Plectranthus scutellarioides* (L.) R.Br (coleus) varieties through the chlorophyll fluorescence transient analysis measurements. Also there was an objective to assess the applicability of OJIP method for plant physiological analysis under stress conditions imposed by different light intensities. "Alabama sunset", "Velvet red", "Finger paint" varieties were arranged in 0% (Full sunlight) and 70% shade levels as two-factor factorial completely randomized design. Sixty days after exposure to 0% and 70% light conditions, chlorophyll fluorescence parameters were measured in fully expanded leaves using Hansatech pocket PEA chlorophyll fluorometer. Resulted values of OJIP transients were analyzed according to the JIP test and the most important functional parameters such as quantum efficiencies (φEo, φPo, ψo) and Performance index (PI_{Abs}). Analyzed data showed that from derived parameters, φEo, φPo, quantum efficiencies and PI_{Abs} values were significantly affected by light conditions and varieties. Higher quantum efficiencies and the higher Performance index were observed under 70% shade compared to the 0% shade (full sunlight). Overall, the contrasting light conditions influence the photosynthesis performance of the coleus varieties and different parameters of OJIP chlorophyll fluorescence transient analysis can successfully be used to study the stress responses for different light intensities in the photosynthesis process.

Keywords: JIP- test, Performance index, Quantum efficiencies

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Impact of bio-fertilizer and urea as sole and in combination on paddy grown in Kilinochchi

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Abstract
The experiment was carried out to evaluate the performance of urea and bio-fertilizers in clay loam soil on the paddy crop (Bg-251) grown by using different fertilizer sources including two types of bio-fertilizer; azolla (symbiotic relationship with Anabaena), and azotobacter, and urea as a chemical fertilizer. Fertilizers were added to treatments based no recommended level of fertilizer for paddy crop by the Department of Agriculture. The treatments including recommended dose nitrogen applied in T1 - 100% of bio-fertilizer (azolla), T_2 - 100% of bio-fertilizer (azotobacter), T_3 – 100% of urea, T_4 - 50% of bio-fertilizer (azolla) + 50% of bio-fertilizer (azotobacter), T_5 – 50% of bio-fertilizer (azolla) + 50% of urea, T_6 - 50% of bio-fertilizer (azotobacter) + 50% of urea and T_7 - control (No fertilizer). The experiment was devised in a randomized complete block design with three replicates. The results revealed the soil electrical conductivity (EC) and soil organic matter content were significantly different among treatment at 30 and 45 days after sowing ($p < 0.05$). The highest soil EC was recorded in azolla + azotobacter treatment at 30 days after sowing and sole azotobacter treatment at 45 days after sowing. The highest organic matter content was recorded in both sole azolla and sole azotobacter treatment at 45 days after sowing. According to the results, it can be concluded that application of bio-fertilizer increased soil organic matter content and soil EC. Therefore, bio-fertilizer could be used as alternative source for chemical fertilizer in paddy cultivation.

Keywords: Azolla, Azotobacter, Electrical conductivity, Paddy, Soil organic matter

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Screening and quality evaluation of Mung bean genotypes for Mung dhal production

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Abstract
Screening of genotypes is a main part of the plant breeding programs. It helps to identify most appropriate characteristics for the particular task which want to be realized. Therefore, this study was carried out to screen mung bean genotypes to identify most suitable genotype/s for mung dhal production. The available 20 local mung bean genotypes were evaluated from 2019 *yala* to 2020 *yala* in the research field at Grain Legume and Oil Crop Research and Development Centre, Angunakolapelessa. Genotypes were screened in row method according to the Randomized Completely Block Design with three replicates. Seed colour, yield, pest and diseases, time taken to cook without soaking, sensory evaluation for uncooked and cooked dehulled splited mung dhal were recorded. Data were analyzed by using SAS statistical software and means were separated using DMRT. The quality data were analyzed using SPSS software. Field screening data revealed green colour coated MB140, MB120, MB127 and MB48 genotypes had the highest rank in average yield. Among those genotypes MB120 was moderately resistance for sucking pest and MB120 with MB127 were moderately resistance for mung bean yellow mosaic virus. According to the proximate analysis dehulled splited mung dhal: (MB102, MB120, MB140, MB127 and MB48) samples were shown > 26% of protein content while protein content of red lentil was around 23%. The unsoaked mung dhal samples: (MB127, MB140 and MB48) were taken significantly less time for cooking. According to the sensory evaluation results, the overall acceptability of uncooked mung dhal samples MB129 (4.33) and MB140 (4.05) were significantly highest in preferred. The overall acceptability for cooked mung dhal samples was not significantly different among each other.

Keywords: Mung bean, Mung dhal, Genotypes, Quality evaluation, Screening

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Effects of fungicide Chlorothalonil on leaf litter decomposition rate and Plankton communities

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Abstract

Pesticides applied into agricultural lands can contaminate waterways and affect the different levels of the aquatic food web and key ecosystem processes underlying the provision of ecosystem services from streams. Chlorothalonil is a commonly used fungicide, in agricultural areas in Sri Lanka, but its effect on non-targets such as in-stream ecological processes is less explored. The objectives of the present study were to assess the effects of Chlorothalonil on leaf litter decomposition rate and freshwater plankton communities. The effect of fungicide Chlorothalonil on *Ficus racemosa* and *Panicum maximum* litter breakdown rate and plankton community composition were assessed in indoor microcosm systems with treatment tanks of Chlorothalonil concentrations: 0.01, 0.025, 0.1, 0.25, 1 mg/L and in control tanks with freshwater for 40 days. The leaf breakdown rates in treatment and control tanks for both leaf types were compared using ANCOVA with time as covariate and plankton counts were compared using one-way ANOVA. The results of the study indicated a significant reduction ($p<0.05$) of litter breakdown rate in terms of % dry weight reduction, % organic matter reduction and % nutrient content reduction in treatment tanks with Chlorothalonil in comparison to control tanks in *Ficus* leaves. Moreover, a significant difference was observed only in the % dry weight reduction and no significant difference was observed in % organic matter reduction and % nutrient content reduction in *Panicum* leaves. The study further revealed that these alterations were further modulated by leaf litter quality and inhibition of microbial colonisations on leaves. Further, a significant reduction ($p<0.05$) of plankton counts was also observed in Chlorothalonil treated tanks in comparison to control tanks after 20 days. The findings of the study suggests that the fungicide Chlorothalonil can have multiple impacts on non-target organisms of litter decomposing organisms and plankton communities and thus affecting the ecosystem processes of aquatic systems.

Keywords: Chlorothalonil, Litter decomposition, Microorganisms, Phytoplankton, Zooplankton

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Effect of different soil nitrogen levels on growth, yield and yield contributing attributes of promising rice (*Oryza sativa* L.) line at 13 2715 and standard variety at 311

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Abstract

Nitrogen (N) is an essential plant nutrient being a component of amino acids, nucleic acids, nucleotides, chlorophyll, enzymes, and hormones. It promotes plant growth yield and quality of grains through increased tillering, leaf area development, grain formation, grain filling and protein synthesis. Application of N fertilizer for rice facilitates growth as well as post-harvest attributes of grains. A research study was conducted at research field of the Rice Research Station, Ambalantota, Sri Lanka during 2019 yala season to investigate the effect of different nitrogen application rates on grain quality, growth and yield parameters of rice. The experiment was established with four nitrogen levels such as 50, 100, 150 and 200 kg N ha^{-1} along with control treatment (0 kg N ha^{-1}) under irrigated water condition and two red pericarps three-month rice varieties (promising rice line At 13 2715 was developed by crossing between At 362 and PSPRC 28 and standard variety At 311). Treatments were arranged in a split plot design with three replicates. The gross plot and net plot area of each experimental unit were 18 m^2 and the 12.96 m^2. Main plots were separated by a ridge (40 cm in width). Phosphorus (45 kg ha^{-1} P_2O_5 - triple super phosphate) was applied at the basal fertilizer application and potassium (20 kg ha^{-1} K_2O as Muriate of potash) was applied to all experimental plots after four and six weeks from seed sowing. Grain yield (t/ha), plant height (cm), tiller count, filled and unfilled grain count per panicle, spikelet count per panicle, 1000 grains weight (g) and straw weight (kg/12.96 m^2) were determined. Analysis of variance was performed using STAR for Windows version 2.0.1. Different soil nitrogen application rates were responded differently on rice crop where zero nitrogen level (0 kg N ha^{-1}) was given the lowest response of both At 13 2715 and At 311. Rice cultivated with higher rate of nitrogen (≥100 kg N ha^{-1}) was given higher grain filling and growth of both verities. Application of 100 kg N ha^{-1} rate was recognized as the significant level for growth, yield and some yield contributing attributes. However, further increasing of soil nitrogen (≥100 kg N ha^{-1}) was not significantly ($p > 0.05$) improved the growth, grain yield and yield parameters of both rice varieties At 13 2715 and At 311.

Keywords: Nitrogen, Quality, Rice, Yield attributes

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Identification of Jack (*Artocarpus heterophyllus)* and Bedidel *(Artocarpus nobilis)* timber species using anatomical features

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Abstract

Timber is considered to be an ecological friendly building material with less construction energy requirements. The Jack (*Artocarpus heterophyllus*) and Bedidel (*Artocarpus nobilis)* species are economically valuable timber species of the Moraceae family. External appearance of both sawn wood is similar in colour. Density values of matured wood is same ranged in both species (625-650 kgm^{-3}). But the industrial uses of Jack and Bedidel are different. As buyers and consumers are not identified of both timber species correctly, they tend to get mislead easily. Wood anatomy is considered to be a precise and rapid method for wood identification. Due to the limited availability of information related to anatomical features of wood species, the present study was aimed at evaluating the anatomical features of Jack and Mahogany timber species. Present practice of timber identification is mainly based on personnel skills as there is no proper systematic mechanism to identify them. In this research, both species were employed in identification of variations in wood anatomical features and distinguishing the species. Authentic timber samples were collected from the Research Division of the State Timber Corporation for this study. Based on the results of the study, Jack and Bedidel timber species could precisely be identified and distinguished using anatomical features: vessels, parenchyma, rays and fiber.

Keywords: Anatomical features, Bedidel, Identification, Jack

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Poster Presentations

Prediction of Green Chilli production in Jaffna, Sri Lanka: ARIMA Approach

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Abstract

Green chilli is one of the most important cash crops grown in Sri Lanka. Also, it has become an essential ingredient in Sri Lankan meals. Observing the fluctuation of Green chilli production is essential in the market economy. The level of the production and its' fluctuation not only has a significant influence on farmers' income and consumer price, but a reasonable and *stable* production also has an irreplaceable effect on the safe running of the chilli market. *The green chilli production is made under two seasons, Yala and Maha*. In this research, the annual production of green chilli in Jaffna was modeled by using Autoregressive Integrated Moving Average (ARIMA) approach. The data were obtained from the Department of Census and Statistics, during the period of 2002 to 2018. The Box-Jenkin's procedure was used to build the ARIMA model for the annual chilli production. Further, Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and Mean Squared Error (MSE) were used to select the best model among some possible models. Through modeling, it was identified that ARIMA (1,1,0) is the best fitting model for the given data. Moreover, the adequacy of the best model was examined using L'jung-box test. Finally, the identified best model was used for short term prediction.

Keywords: ARIMA model, Box-Jenkin's procedure, Chilli production, Prediction, Time series

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Heterosis and Heterobeltiosis studies on morphological traits of F_1 generation of two crosses in Rice (*Oryza sativa* L.)

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Abstract
The rice crop grown in low country wet zone of Sri Lanka, especially in river basins close to the coastal areas, subjected to frequent flood and salinity conditions. Therefore, there is a need to develop improved varieties for both salinity and submergence tolerance. With the objective of salinity and submergence tolerant variety improvement, generation advancement of two crosses (Cross 1: At 354/Bg 455, Cross 2: Ld 12-22-2-1-1/ Ld 13-5-7) were carried out at Rice Research Station (RRS), Labuduwa, using submergence (Bg 455 and Ld 13-5-7) and salinity (At 354 and Ld 12-22-2-1-1) tolerant parents. Estimation of genetic parameters of growth and yield characteristics was carried out using F_1 of two crosses and respective parents established at RRS at Labuduwa during 2014/15 *Maha* Season. Both crosses showed positive heterosis and heterobeltiosis in number of panicles per plants, flag leaf length, flag leaf width, number of seeds per panicle, weight of seeds per panicle and seeds width. The estimated genetic parameters indicated that with respect to both crosses there is a possibility to have transgressive segregants for above mentioned important yield components of rice in subsequent generation selections.

Keywords: Heterobeltiosis, Heterosis, Rice

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Effect of different coloured Light-emitting Diodes (LEDs) on the selected growth attributed traits of Rice (*Oryza sativa* L.)

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Abstract

Rice (*Oryza sativa* L) is the second most important cereal crop in the world and the staple food in many Asian countries. In Sri Lanka rice is cultivated during *Yala* and *Maha* seasons and produces about 95 % of its total rice requirement. Even though, Sri Lanka is nearly self-sufficient in rice, a further increase in rice production is needed to cater to the growing population. Light plays a major role in plant growth and development by regulating diverse physiological and morphological processes in rice plants. The rate of photosynthesis and yield directly depends on the intensity of photosynthetically active radiation. The yield would be reduced under low light intensity and duration. During the Maha season in the dry zone of Sri Lanka, light intensity is reduced due to the cloud cover, thus rice plants do not receive the optimum level of light. In this experiment, we investigated the possibility of using light-emitting diodes (LED) with different wavelengths to provide supplementary light for the rice plant. Red LED (628 nm), blue LED (445 nm), and red and blue combinations were used in the experiment as supplementary light. For the control, no supplementary light was used. Rice plants (BG 251) were grown in 2 L pots filled with Yoshida nutrient solution. Twelve plants were used for each light treatment and the plants were kept inside a glass house allowing the plants to get normal sunlight during the daytime. Supplementary lighting was done from 6.00 p.m. to 10.00 p.m. All supplementary light had a similar light intensity level (50 µmol m^{-2} s^{-1}). When compared with the control, the highest plant height, root depth, and SPAD meter values were observed in the blue light treatment. These values were 15.1% plant height, 17.2% root depth, and 32.1% (SPAD) higher than the control, respectively. Plants exposed to red and blue-red combination also had significantly higher values than that of the control. Results of this experiment showed that by providing blue, red, and red-blue light combination for 4 hours at night time, plant height, root depth, and SPAD meter values of the rice plants can be increased.

Keywords: Different wavelengths, LED light, Plant and root growth, Rice plants

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Pesticide usage pattern of vegetable cultivation in Nuwara Eliya divisional secretariat division, Sri Lanka

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Abstract

In Sri Lanka, Nuwara-Eliya District is most popular for upcountry vegetable cultivation in Sri Lanka. Potato, carrot, leeks, beetroot, and cabbage are the most important vegetable crops cultivated in the Nuwara Eliya area. The study was conducted to determine the types of pesticides that are frequently used by farmers, to estimate the usage pattern of pesticides, to find out determinants of pesticides used by farmers, and to estimate knowledge about safety measures used by farmers. Structured questionnaires were designed to gather the required information. 10% of farmers who engaged in vegetable cultivation were selected through random sampling from various Grama Niladari Divisions, and they were interviewed at their doorsteps, and field observations were also made. The survey stated that most of the respondent farmers were male (84.5%), within 41-50 years of age bracket (33.6%), and had achieved a secondary education (20.9%). Maximum of respondents (30.9%) had 11-20 years of experience in farming. The study stated that the chemical control method was the prime method adopted by all farmers in controlling the pest and diseases. It was noted from the survey that 60.4% of farmers applied the pesticides mixed with some other pesticides. The frequently (16 times) used insecticides were Profenofos, Carbosulfan, Chlorantraniliprole and Spinosad and fungicide was Mancozeb. The analysis stated that 91.8% of farmers in the study area used high dosages, where potato farmers applied more than 20 times per season. The results showed a significant positive correlation between age, experience, and mixing pesticides, whereas a significant negative correlation between education and mixing pesticides. The survey exhibited that 63.6% of farmers store pesticide bottles on a safe location, which is inaccessible to children. Ninety percentages of the farmers are throwing or dumping the empty pesticide bottles in bush areas adjacent to cultivation fields. It was concluded that Sri Lankan farmers are using hazardous pesticides with an increased frequency of applications and mixing different pesticides to fight against pest resistance.

Keywords: Cocktail pesticides, Fungicide, Insecticides, Nuwara Eliya

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Effects of gamma-rays on Sprouting of Eggplant seeds (*Solanum melongena* L.)

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Abstract
Gamma irradiation has a great potential to develop new crop varieties quantitatively and qualitatively. An experiment was conducted to identify the optimal gamma-ray dose for mutational breeding of eggplants at the Department of Agricultural Biology, University of Ruhuna, in 2019. Seeds of eggplants (variety SM 164) were subjected to five different gamma irradiation doses (100, 200, 300, 400 and 500 Gy). The irradiated and untreated seeds (0 Gy) were sown in tray nurseries and the experiment was carried out using completely randomized design (CRD) with 50 replications. The germination percentage (GP), shoot length (SL), and leaves per plant (LPP) were recorded. The data were analyzed using analysis of variance (ANOVA) followed by Tukey post hoc test using SPSS (Version 22). The results revealed that 100 % germination in controls while showing a declining trend with increasing dose level. The SL and LPP were significantly ($p<0.05$) affected by the irradiation dose. Similarly, the highest SL was observed in the control group (5.26±0.16 cm) 2 weeks after seed sowing, while the highest LPP observed in 100 Gy dose level (3.20±0.10) and (4.06±0.06) in two and three weeks after seed sowing respectively. In addition, characters (GP, SL and LPP) of each seedling in the control, 100 Gy and 200 Gy doses had significantly higher values compared to rest of the doses. Therefore, the present study concluded that high gamma irradiation doses 300, 400 and 500 Gy could be used for future studies for the successful induction of genetic diversity in eggplants to enhance suitable mutants for breeding purposes.

Keywords: Gamma-ray, Germination, Mutant, Mutational breeding, *Solanum melongena*

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Comparison of final yield and leaf colour of four Rice cultivars under different N-fertilizer levels

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Abstract

The selection of fertilizer responsive rice varieties is one of the important criteria in rice improvement programs. Fertilizer responsiveness is important to reduce the cost of production and minimize the possible environmental pollution caused by excessive application of inorganic fertilizers. This study was conducted at the RRDI, Batalagoda in 2020/21 Maha season to compare the performances of four rice varieties under different nitrogen (N) fertilizer rates. Two aerobic rice varieties (Aeron 9-3, Aeron7-11), one promising rice line (Bg15-520) and the most popular rice variety Bg352 were planted under four different N rates (0, 50, 100 and 150 kg/ha). Five weeks after the planting, leaf colour was recorded and grain yield was recorded at harvesting. Results revealed that the leaf colour is an important indicator for N-fertilizer responsiveness under Sri Lankan conditions. It is found that two rice varieties (Aeron 9-3, Aeron 7-11) which were developed to increase the water use efficiency recorded the potential yield at low-N-fertilizer levels as well. Rice varieties Aeron 9-3 and Aeron 7-11 had absorbed required N, even at low N-fertilizer levels and had improved greenness as well. Further, rice variety Aeron 9-3 reported the potential yield at all the tested nitrogen levels. The maximum agronomic N use efficiency (22.1 kg/kg N) was recorded by Aeron 9-3 at the recommended N-fertilizer application (100 kg/ha). Interestingly, the yield recorded by the mostly grown rice variety Bg 352 in Sri Lanka, at N-fertilizer rate of 100 kg/ha can be obtained by Aeron 9-3 at the rate of 50 kg/ha. Introduction of Aeron 9-3 will cut down the N fertilizer application considerably in the farmer fields.

Keywords: Aeron 9-3, Agronomic N use efficiency, Leaf colour N fertilizer

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Effect of growth regulators on growth enhancement of Mangosteen (*Garcinia mangostana*) seedlings

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Abstract

Mangosteen (*Garcinia mangostana)* belongs to family Clusiaceae considered as one of the highest demanded tropical fruits with a higher economical potential. In Sri Lanka, Mangosteen plants found as backyard plants or small cultivations in both mid and wet low-country areas. This plant has inherent slow growth habit with long juvenile period of 8-12 years to bear fruits and seedlings should be maintained at the nursery for 02 years or more. Therefore, it is important to investigate possible growth enhancement at the nursery stage to expedite early growth and development of mangosteen. For this purpose, an experiment was carried out at Fruit Research and Development Institute, Kananwila, Horana, Sri Lanka during October 2019 to February 2020. Nine treatments were formulated with sole and combined application of Gibberellic Acid (GA_3) and Cytokinin (6-Benzylaminopurine/6-BAP). Treatments were arranged in Randomized Completely Block Design (RCBD) with three replicates. Hormones were applied at weekly intervals for 12 weeks as foliar sprays. The growth measurements of stem height (cm), internodal length (cm), stem diameter (mm) and number of leaves were taken at two weeks' intervals. Results revealed that, combine application of Gibberellin 200 ppm + Cytokinin 100 ppm (T8) had the highest stem height (6.0 cm) and internodal length (2.13 cm). The same treatment also resulted in relatively high stem diameter (1.36 mm) and number of leaves (3.9) at the end of 12 weeks' period.

Keywords: Gibberellic Acid (GA_3), 6-Benzylaminopurine (6-BAP), Growth enhancement, Mangosteen seedlings

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The performance of different nodal cuttings under different hormornal combinations in Micropropagation of *Anoectochilus roxburghii*

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Abstract

Anoectochilus roxburghii is an endangered medicinal and highly valued ornamental plant belongs to family Orchidaceae. Extinction of this species has been identified over last few decades due to over wild-collection, loss of favorable habitats, slow growth and low rate of proliferation. Conventional propagation has been identified as an inefficient and time consuming method in propagation of this species. Micropropagation is considered as the technique which ensures rapid multiplication of plants including many other benefits compared to conventional propagation. The objectives of the present study were to find out the best nodal cutting of this species for in-vitro propagation and select appropriate hormonal combinations with full MS media for shoot proliferation. The experiment was carried out using complete randomized design with six treatments combinations replicating three times with three cultures. Six treatments consisted of three types of nodal cuttings (explant) as first, third and fifth nodes either with 1.5 mL^{-1} of 6-(BAP) or with combination of 1.5 mL^{-1} of 6-(BAP) and 0.5 mL^{-1} of α–naphthaleneacetic acid (NAA). Data were recorded at the fourth, sixth and eighth weeks after establishment. The highest number of multiplied shoots were recorded in 3rd nodal cutting with full MS media supplemented with 1.5 mL^{-1} BAP at eight weeks after establishment and it also showed that the shortest time for initiating shoots within two and half weeks. Most of the culture vessels were contaminated after four days of establishment. According to observations, MS media treated with 1.5 mL^{-1} of BAP performed better in in-vitro culture establishment and organogenesis (shoot) of *Anoectochilus roxburghii* nodal cuttings. Third nodal cuttings performed better in culture establishment and organogenesis under full MS media treated with 1.5 mL^{-1} of BAP. Lower nodal cuttings closer to growth media of mother plants were more susceptible for microbial contaminations when used as explants in in-vitro cultures.

Keywords: *Anoectochilus roxburghii,* BAP, Nodal cutting, NAA, Organogenesis

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A survey study on salinity and flood affected Rice fields of costal belt of Galle district of Sri Lanka

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Abstract
Paddy fields existed in the costal belt of Galle district probably below the mean sea level, prone to salinity and submergence due to sea water intrusions in high tidal effect during dry spell and poor drainage during heavy rains. Identification of constrains is a prior requirement to implement appropriate technologies with respect to this specific agro-ecosystem. Hence farmers were interviewed with a scheduled questionnaire by purposive sampling of 38 paddy cultivating farmers respectively from three clusters of Bentota river basin and vicinity of Rathgama and Koggala lagoons. The highest occurrence of salinity and submergence effect found in Bentota river basin and paddy fields of Dedduwa, Thunduwa, Haburugala, Horavila, Moragoda, Ranthotuwila and Thotakannaththa were undergone frequent salinity and submergence effects. Pellassa, Lanumodara and Thiththagalla close to Koggala lagoon and Kandegoda, Katudampe and Dodanduwa of Rathgama lagoon were also affected. Yield levels were very poor and ranged from 1.5 to 2.5 t/ha of the surveyed farmers. Most of the farmers (86%) were unaware about the tolerant rice varieties for salinity and submergence. Survey revealed that 72% of farmers are not following proper methods to control salinity while 89% farmers also not following any control measures for submergence. Farmer adaptation for remedial measures such as adding Dolomite and organic matter (8%), salinity and flood controlling gates (5%), parachute and transplanting (3%) and cleaning of water channels (6%) and application of paddy husk charcoal (6%) at very minimal level. The studied locations were prone to salinity and submergence and famers requested for controlling system of high tide flow with proper drainage channel system and control gates. Further salinity and submergence tolerant varieties and appropriate agronomic practices are required by the farmers of affected paddy fields.

Keywords: Constrains, Paddy cultivation, Salinity, Submergence

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Enhancement of seed germination by pre-plant treatments of *Cyrtostachys renda* (Red palm)

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Abstract

Red palm (*Cyrtostachys renda*) is an eye-catching palm variety, which can be used outdoor and indoor. This wonderful plant has continued demand in Sri Lankan landscaping sector in the last few decades because of its attraction with characteristically bright red leaf sheaths around the stems. The seeds of red palm show an uneven and long germination period, therefore, the present study was aimed at assessing the effect of different seed treatments on seed germination of *C. renda.* The experiment was conducted in Henarathgoda Botanical Garden Gampaha from July 2018 to January 2019. Completely Randomized Design (CRD) was used with five replicates each contain 10 seeds. Seed soaked in water (T1-control), soaked in hot (40 ^{o}C) water for three days (T2), soaked in 1% $KMnO_4$ for three days and added 1% $KMnO_4$ on weekly basis (T3), soaked in 1% $KMnO_4$ for three days (T4), soaked in 1% $KMnO_4$ solution per 36 hours followed by soaked in 1.5% H_2O_2 solution for 36 hours (T5), soaked in a 1.5% H_2O_2 solution for three days (T6) and soaked in 20 ppm GA3 solutions for three days (T7) applied as treatments. Germinated seeds were counted weekly up to 24 weeks after seeds sowing. According to the results, T7 had the significantly earliest (14th weeks after seed sowing) and significantly the highest germination percentage (72% in 23rd weeks after the sowing of seeds). The seeds treated with T5, T2 and T6 shown a 22% of germination percentage as their highest value while seed treated with T3 and soaked in T4 given 12%, 8% of germination percentage as highest value respectively. Further, the lowest seed germination percentage (6% in the 24th weeks after seed sowing) was recorded from the seeds in control. Thus, the present study is revealed that GA3 20 ppm treatment has enhanced seed germination by increasing germination percentage and reducing the germination period. Therefore, GA3 20 ppm is considered as an applicable seed treatment for *C. renda*.

Keywords: *Cyrtostachys renda*, GA3, Seed germination, Seed treatment

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Development of a sterilization protocol for *in-vitro* regeneration of Turmeric (*Curcuma longa*)

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Abstract

Turmeric are commercially cultivated by vegetative propagation method as it has a very rare flowering ability. Even though, vegetative propagation through rhizome is done their multiplication rate is very low and also there is a high contamination rate of propagating materials. The use of in vitro culture techniques for large scale propagation of turmeric is a current trend. Therefore, the study was focused on developing a proper explant sterilization protocol which is a major pre-requisite for a successful in vitro culture. The experiment was laid out in a two-factor factorial complete randomized design (CRD). The data were analyzed using analysis of variance (ANOVA) and SAS statistical package (Version 9.1). Sprouting rhizomes of turmeric were cleaned and washed with a soap solution for 10 minutes and washed with distilled water. Then treated with a 0.4% (w/v) Carbendazim (fungicide) solution for 10 minutes and treated with 70% ethanol for 1 minute. Buds were then treated with 10%, 20%, 30% and 40% commercially available Clorox for 5, 10, 15 and 20 minutes. For each treatment 10 buds were used, where 3 replicates were performed for each treatment. They were introduced to MS (Murashige and Skoog) medium to observe the growth and contamination. Data were collected after 4 and 6 weeks of culture. The results showed the significantly highest survival rate (80%) of rhizome buds from the treatment 30% Clorox for 20 minutes and 40% Clorox for 15 or 20 minutes. Therefore, it can be recommended to use 30% Clorox for 20 minutes to ensure the provision of disease free viable buds for *in vitro* propagation of turmeric.

Keywords: *in vitro*, Propagation**,** Sterilization, Turmeric

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Assessment of deforestation drivers in Sri Lanka

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Abstract

Sri Lanka has a striking variety of forest types brought about by spatial variations that can be simply classified as tropical rain forests. Deforestation is an incidence of removal of trees and the conversion from forest vegetation into non-forest vegetation and other land uses, which is responsible for 17–25% of annual greenhouse gas emissions that are a principal factor in global warming. State of deforestation in Sri Lanka is controversial in both scope and quantity and understanding drivers of deforestation is fundamental to the development of policies and measures that can incorporate to amend current status of deforestation activities toward more favourable environment-friendly outcome. Aim of this study was to assess the determinants of deforestation to better understand patterns and intensity of deforestation in Sri Lanka during the past three decades. Data were taken through two secondary sources; Food Agriculture Organization of the United Nation (FAO) and Department of Census and Statistics for the period from 1990 to 2016. A structural model was used to approximate the causes of deforestation and burnt forest area. Results revealed that the forest area has been decreased from 1990 to 2010 and began to remains nearly at a steady level which shows the success of some national wide reforestation and afforestation programmes. Interestingly, income, agricultural gross domestic products, crop production, crop production area, poverty, population, literacy rate, agricultural labour force and agricultural land area has significant impact (at 95% confidence level) on the forest cover change while none of the factors make any significant impact towards burnt tropical forest cover. Country's tropical forest cover is still in danger due to some other reasons that could not reveal through this study and yet to be studied in future.

Keywords: Deforestation, Drivers of deforestation Structural model, Tropical forests

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Evaluation of temporal changes of nutrient composition of vermiwash and the impact of vermiwash on seed germination and early vegetative growth of *Solanum lycopersicum*

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Abstract

Vermiwash is a liquid extract and an organic medium containing macro and micronutrients, plant growth hormones and beneficial microorganisms. The present study was undertaken to (i) evaluate the chemical characteristics and macro-nutrients present in the vermiwash and to study the changes of those parameters with the storage time and (ii) to study the effect of vermiwash on seed germination and on early vegetative growth of tomato (*Solanum lycopersicum*) variety Thilina, measured up to 18 days from planting. In order to prepare the vermiwash, a 500 L tank was filled with layers of broken pebbles, coarse gravel, sand and as organic materials chopped grasses, leaves of *Gliricidia sepium,* paddy straw and partially decomposed cow dung were incorporated along with locally available earthworms (*Eudrillus* spp.). After five days of establishment, vermiwash was collected daily for 14 days, and four different concentrations of vermiwash were prepared as treatments which were selected based on preliminary experiments (10%, 25% and 50%, and water for control). To study the effect of vermiwash on germination and early growth of tomato, 20 mL from each concentration of vermiwash were carefully applied, to the tomato plants grown in trays and each treatment had 5 replicates, having 23 plants for each replicate. According to the analysed results of established vermiwash, pH and electrical conductivity (EC) have slightly changed whereas total nitrogen content and phosphorous content have significantly increased while Potassium content have exhibited a significant decrease. The pH and EC of stored vermiwash, which was kept in dark for 14 days, have not shown any significant change with time. In the plant house study, a significantly higher germination percentage was observed in the plants treated with 25% vermiwash. When the early growth is considered, root length, shoot length and dry weights were significantly higher in the vermiwash treated plants, compared to control, from which, the 50% concentrated vermiwash had better results compared to 10% and 25%. The present study suggests that systematically prepared vermiwash is an effective biofertilizer which would facilitate increased uptake of nutrients by the plants resulting in higher shoot length, root length and dry weight.

Keywords: Earthworms, Growth parameters, *Solanum lycopersicum*, Vermiwash

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Impact of spatial pattern and planting material on yield indices of Cinnamon

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Abstract

Cinnamon (*Cinnamomum verum* J. Presl) is a prominent spice throughout the world which largely produced in the down south of Sri Lanka. As bark is the major harvestable portion, the yield determining factors of cinnamon are quite different from many other crops. Therefore, three yield indices have been recognized for cinnamon in previous studies as number of harvestable stems per plant, length of the harvestable stem and the unit bark weight which determine the bark yield of cinnamon. This study was conducted to identify the effect of spatial pattern and type of planting material on yield indices of cinnamon. Seedlings and vegetatively propagated plants of cinnamon; variety Sri Gemunu of same maturity were planted under three different spatial patterns as 1.2×0.6 m with three plants per hill, 1.2×0.4 m with two plants per hill and 1.2×0.2 m with one plant per hill as two factor factorial RCBD with four replicates at the Faculty of Agriculture, University of Ruhuna, Sri Lanka. The plant density was equal (41,666 plants/ha) for all treatments. First harvest was collected after two years from establishment and the next two harvests were collected in six months harvesting intervals. Four middle trees from the middle row from every treatment were used for data collection. Number of harvestable stems per plant and the lengths of harvestable stems (length with brown bark) were recorded during harvesting. Total dry weight of bark was recorded by oven drying samples to a constant weight and unit bark weight was calculated. The results revealed that, only the impact of planting material was significant for the number of stems harvested per plant during all three harvests. The number of stems harvested in seedlings (22,875 stems/ha) was significantly higher ($p < 0.05$) than vegetatively propagated plants (17,602 stems/ha). When considering the harvestable length of a stem, the interaction effect between spatial pattern and type of planting material was significant ($p < 0.05$). Reduced spacing with less number of plants per hill has been affected favorably for seedlings (189 cm) while wider spacing with higher number of plants has been affected favorably for vegetatively propagated plants (125 cm). Interaction effect between spatial pattern and type of planting material or effect as an individual factor has not been influenced on unit bark weight of cinnamon during first three harvests. The knowledge gathered during this study will be helpful for the future productivity enhancement studies of cinnamon.

Keywords: Bark yield, Cinnamon, Seedlings, Spatial pattern, Vegetatively propagated plants

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Comparison of phenology stages of wild rice species: *Oryza nivara* and *Oryza rufipogon* using *Ex-situ* common garden experiment

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Abstract

Common wild rice species, annual *O. nivara* and perennial *O. rufipogon* are closely related to Asian cultivated rice and progenitors of modern rice cultivars. Observations of phenology stages and their divergence were important to understand their life history patterns to select candidate parents for breeding purposes. An *Ex-situ* common garden experiment was conducted using seeds collected from two natural populations of each species. *O. nivara* seeds were collected from Kilinochchi and Vavuniya in the dry zone and *O. rufipogon* seeds were collected from Thihagoda and Seeduwa in the intermediate zone. Seedlings were transplanted for 30 individuals per population at the Faculty of Agriculture, University of Ruhuna. Life cycle observations were recorded for one year. The findings revealed that the highest survival rate belongs to *O. rufipogon* (85%, Thihagoda and 90%, Seeduwa) whereas, *O. nivara* showed a comparatively low survival rate (75%, Kilinochchi and 55%, Vavuniya). After 49 ± 13 days of transplanting, panicle emergence was appeared in *O. rufipogon* (Thihagoda) indicating the shortest vegetative stage while Seeduwa recorded 54 ± 17. However, *O. nivara* (Vavunia) recorded the longest vegetative stage about 59 ± 2 days while Kilinochchi recorded 56 ± 3 days. Duration from Panicle emergence to 50% heading was comparatively low in *O. nivara* (15 days) than that of in *O. rufipogon* (25 days). The reproductive period of *O. nivara* (157 ± 13 days) seemed shorter compared to *O. rufipogon* (243 ± 19 days). Further, perennial *O. rufipogon* being a short vegetative period for 88 ± 11 days (Thihagoda) and also began next flowering period due to its bi-model flowering nature. After reproductive stage, *O. nivara* no longer exists in the field owing to its annual nature. There were no clear differences in phenology stages among populations in respective species. Conclusively, both species showed nearly similar patterns of phenology stages. These findings may help to design successful breeding practices, germplasm collection and implementing conservation strategies of these valuable genetic resources.

Keywords: Life cycle, Life history traits, Species survival rate, Wild rice

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Responses of selected traditional Rice (*Oryza sativa*) accessions to short day photoperiods at early vegetative phase of the plant

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Abstract
Photoperiod sensitivity is a major factor determining spatial and seasonal adaptation of rice. Most of traditional rice is grown under *Maha* season, during which the short day photoperiods are available. Determination of effective photoperiod for traditional rice is important for the optimization of their productivity. This study was carried out to determine the effect of minor variations of short day photoperiods on vegetative growth of selected traditional rice. Six traditional rice accessions (4666, 8541 and 8543 of *Maha ma wee*, 4561 of *Ma wee samba* and 4134 and 4136 of *Ma wee*) from Plant Genetic Resources Centre, along with a new improved rice variety Bg 300 were grown in three replicates in mud pots. The pots were placed in a photoperiod chamber, which received sunlight with controlled exposure times of 11.66, 11.75 and 11.83 hours from October 2020 to December 2020. Days to fifth leaf (DFL) and plant height at fifth leaf (HFL) were recorded. The highest and the lowest DFL were 40±1.53 (4561) and 30 (4134) days, respectively. The DFL of accessions 4134, 4666 and 8543 were significantly affected by photoperiod as 11.66 hours of light increased the DFL. Accessions 4136, 4561, 8541 and Bg 300 were not affected by photoperiod for DFL. The variation of HFL was 41.83, 0.44 (4134) to 60.17±1.58 (8543) cm, respectively. HFL of 4134, 4136, 4561 and 8541 were significantly increased under the 11. 75 hours of light, while that of 8543 was increased under the 11.83 hours of light. HFL of 4666 was not affected by photoperiod. HFL values of Bg 300 under the 11.75 hours and 11.83 hours (37.83±1.17 and 36±0 cm, respectively) were significantly higher than that of 11.66 hours (31.67±1.2 cm). According to the above results, there is a variation in measured responses of rice accessions to the three photoperiods, which is useful for breeding rice for desirable agronomic characters.

Keywords: Days to fifth leaf, Early vegetative phase, Photoperiod, Sri Lankan traditional rice

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Effect of selected bacteria isolates on the yield of three improved Rice (*Oryza sativa*) varieties under greenhouse condition

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Abstract

Rice (*Oryza sativa*) supplies the staple food for nearly 50% of the global population. Higher rice production for increasing population is achieved through intensive agricultural practices including the use of chemical fertilizer. Excessive use of chemical fertilizers has adverse effects on human health and the environment. Plant Growth Promoting Bacteria (PGPB) are an alternative to the chemical fertilizer. Determination of the efficient PGPB for selected crops is essential for improvement of their productivity. The objective of this study was to determine the effect of two selected bacteria isolates of rice (I-1 and I-2) on the crop duration and yield of three improved rice varieties under greenhouse condition. The Experiment was conducted at Faculty of Agriculture, University of Ruhuna, Mapalana (in ecological zone WL2), from August to December 2018 at average monthly temperatures of 33.23 ℃±1.59, 34.16 ℃±3.79, 35.26 ℃±3.26, 33.8 ℃±1.6 and 32.4℃±1.79. Surface sterilized seeds of three improved rice varieties Bg 300, At 308 and Bg 379/2were inoculated using the two bacteria isolates, I-1 and I-2. The treatments were laid in a completely randomized design (CRD) with five replicates. The days to flowering (DF) of each treatment were recorded and the number of grains per first panicle (GP) was measured as a yield component. Data was analyzed using SAS software for ANOVA and Duncun's Multiple Range Test (DMRT) for mean separation. The plants of Bg 300 and Bg379/2, inoculated with I-1, reported significant low DF as 114.5±1.25 and 112.5±0.86 in contrast to those of control plants of 117.5±0.5 and 118.5±1.22 DF, respectively. The Bg379/2 plants inoculated with I-2 (of 114.5±0.25 DF) also flowered early in contrast to control plants. Plants of Bg 300 and Bg 379/2 with I-1, produced the highest GP as 134±7.35 and 157±11.2, respectively over those of the control plants of Bg 300 and Bg 379/2 (105.75±6.98 and 132±2.94 respectively). Bacteria inoculation did not affect DF and GP in the variety At 308 indicating the differences in varietal responses on the inoculation. Variety and location interaction must be investigated for I-1 under field conditions for its utilization as a bio-fertilizer for rice in the future.

Keywords: Plant Growth Promoting Bacteria, Rice, Yield

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Livestock, Poultry and Aquaculture

Keynote Speech

The role of probiotics in the poultry industry

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Abstract

The poultry industry has become an important economic activity in many countries. In large-scale rearing facilities, where poultry are exposed to stressful conditions, problems related to diseases and deterioration of environmental conditions often occur and result in serious economic losses. Prevention and control of diseases have led during recent decades to a substantial increase in the use of veterinary medicines. However, the utility of antimicrobial agents as a preventive measure has been questioned, given extensive documentation of the evolution of antimicrobial resistance among pathogenic bacteria. So, the possibility of antibiotics ceasing to be used as growth stimulants for poultry and the concern about the side-effects of their use as therapeutic agents has produced a climate in which both consumer and manufacturer are looking for alternatives. Probiotics are being considered to fill this gap and already some farmers are using them in preference to antibiotics. Over the years the word probiotic has been used in several different ways. It was originally used to describe substances produced by one protozoan which stimulated by another, but it was later used to describe animal feed supplements which had a beneficial effect on the host animal by affecting its gut flora. The main sources of probiotics in poultry are strains of microorganisms such as *Lactobacillus*, *Enterococcus* and *Bacillus* and fermented dairy products like yoghurt, cultured buttermilk and cheese. A good probiotic is characterized by its ability to exert a beneficial effect on a host, resistance to low pH and bile salts, adhere and colonizing of the intestinal epithelium, non-pathogenic to host and produces antimicrobial substances towards pathogens. It also boosts immune responses, improves the growth performance and productivity of poultry and increases the quality of meat and egg. This Keynote will discuss the principles, mechanisms of action and criteria for selection of probiotics, and to summarize their applications in the poultry industry.

Keywords: Disease control, Immune response, Growth performance, Poultry, Probiotics

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Oral Presentations

Quality and the extent of adulteration of raw milk – A study in Southern province of Sri Lanka

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Abstract

Milk adulteration is a serious issue especially in developing countries where adequate quality control facilities are less available. The present study was carried out during 2019 to investigate the quality and the extent of adulteration of raw milk reaching chilling centers belong to Milk Industries of Lanka Company (MILCO) Private Ltd situated in three Districts (Matara, Galle, and Hambantota) of Southern Province in Sri Lanka. Raw milk brought by individual farmers and from milk collecting points were thoroughly mixed at chilling centers and were separately collected into 250 mL screw capped cleaned dry sample collection bottles. Collected samples were immediately transported in ice boxes to the laboratory of the Department of Animal Science, Faculty of Agriculture, University of Ruhuna for analysis. Total 78 milk samples were analyzed using standard procedures for pH, titratable acidity, specific gravity (SG), composition, heat/alcohol stability and for the presence of adulterants (ammonium sulfate, cane sugar, formalin, salt, starch and detergents). Data were analyzed using SPSS (ver. 20). Mean total solids (TS) and the solid nonfat percentage of the milk from Hambantota district was observed to be significantly *(p*<0.05) higher compared to the other two districts. Mean TS and SG of milk from Matara district was lower than the average values for cow milk. Titratable acidity of milk from all locations was observed to be normal and within the acceptable level. It was found that 17.95% of milk samples were positive only for the detergents but none of the other adulterants tested. Milk from Hambantota was found to have the highest percentage of samples failing alcohol and clot on boiling tests (20 and 15%, respectively), followed by Galle (11.5 and 7.7%) and Matara (3.1 and 0.0%) districts. Milk adulteration seems to be controlled by application of proper testing protocol in chilling centers.

Keywords: Adulteration, Chilling centers, Compositional quality, Detergents, Milk

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Length-weight relationship, trophic niche partitioning between exotic Cichlid (*Oreochromis niloticus*) and selected indigenous fish species in Nagadeepa Maha Wewa, Badulla, Sri Lanka

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Abstract

The introduced species *Oreochromis niloticus* in Sri Lankan reservoirs contributes significantly towards the inland fish production which accounts for over 60 percent of inland fish. However, the existence of *O. niloticus* in Sri Lankan reservoirs is often debated for threatening the indigenous fish fauna excluding the opinion, "*O. niloticus* as a species for filling the vacant niches in Sri Lankan reservoirs". In this context, the present study aims to understand the food and feeding habits of introduced cichlid *O. niloticus* and two indigenous fish species *Wallago attu* and *Dawkinsia singhala* in Nagadeepa Mahawewa, Badulla, Sri Lanka. A total of 91 middle size fish from *Oreochromis niloticus* (n = 38), *Wallago attu* (n = 16) and *Dawkinsia singhala* (n = 37) belongs to three fish species groups were sampled and analyzed for stomach content analysis. The stomach contents were identified and analyzed using the frequency of occurrence methods. The trophic niche breadth was calculated using Levins' measure of the standardized trophic niche breadth and Pianka's index was used to calculate dietary overlap between the species. Length-weight relationship of *W. attu* and *D. Singhala* was also determined. The length-weight relationship of *O. niloticus* and *W. attu* indicated that isometric growth (b~3) and the condition factor (K) (*O. niloticus*;1.89 and *W. attu*; 0.53) indicate the healthiness of both species. Diverse food items ranging from phytoplankton to macrophytes in the fish's stomach were recorded. Food items of the *O. niloticus* and *D. singhla* indicated that the omnivore feeding behaviour while the *W. attu* exhibited carnivore. The standardized niche breadths of the three species were ranging from 0.94-0.18 indicating the highest niche breadth for *O. niloticus* and the lowest for *W. attu*. Pianka's index revealed that, high dietary overlap (1.43) between *O. niloticus* and *D. singhala* and lowest dietary overlap (0.32) between *O. niloticus* and *W. attu*. The higher dietary overlap between *O. niloticus* and *D. singhala* and may be linked to increase the intraspecific competition under resource depletion which is highly unlike in Sri Lankan reservoirs. Investigations through more accurate and advanced methods (i.e., stable isotope analysis) may be important for further delineating the trophic relationship among the species.

Keywords: Condition factor, Feeding ecology, Resource partitioning, Tilapia, Trophic niche breadth

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Chronic exposure of iron on growth performance, survival and histological alterations of Guppy (*Poecilia reticulata*)

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Abstract

The present study was designed to evaluate the chronic exposure of iron (Fe) on the growth, haematological and histological parameters of the Guppy (*Poecilia reticulata*). This experiment was conducted with four iron concentrations (3 ppm: Fe-3, 5 ppm: Fe-5, 10 ppm: Fe-10 and 20 ppm: Fe-20) and the control which does not contain added iron. The lowest concentration of iron is based on the maximum tolerance limit for the discharge of industrial wastewater into inland surface waters (3 ppm) which has been recommended by the Board of Investment (BOI) of Sri Lanka. Fifteen male fish with an initial mean weight of 0.20±0.04 g were randomly assigned in triplicated treatments and the experiment lasted for 45 days. Daily food consumption and survival of the experimental fish were recorded and weight measurements of fish were taken fortnightly. At the end of the experiment, growth performances and feed utilization efficiencies were assessed by using percentage specific growth rate (%SGR), percentage average daily gain (%ADG) and feed conversion ratio (FCR). Red blood cell count (RBC), blood smears and histological variations of gill tissues of the experimental fish were also examined at the end of the experiment. Mean body weight was not affected by the treatments. There were no structural alterations observed in blood smears of fish in different treatments. The lowest FCR (1.35±0.07) was observed in Fe-3 while the highest %ADG and %SGR both were observed in the control (4.30±1.21 and 2.37±0.44). Significantly ($p<0.05$) the highest survival rate (100%) was observed in control followed by Fe-3 (86.7±2.6%), Fe-5 (82.0±2.5%), Fe-10 (73.3±1.4%) and Fe-20 (10.0±0.7%). Among tested treatments, the highest RBC was reported in the control and Fe-3 (1.83±0.30 $\times 10^6/mm^3$ and 1.92±0.49 $\times 10^6/mm^3$ respectively) followed by Fe-5 (1.22±0.31 $\times 10^6/mm^3$), Fe-10 (0.99±0.21 $\times 10^6/mm^3$) and Fe-20 (0.61±0.13$\times 10^6/mm^3$). Histological sections of the gill tissues showed that secondary lamellae were arranged without proper order and were visualized as broken or eroded, fused and misshaped filaments in the high Fe levels. However, these alterations were not observed in the Fe-3. The results of this study revealed that there is a significant effect of the chronic exposure of iron on the growth performance, red blood cell counts and histological status of the gills of the guppy at the concentrations greater than the BOI recommended level (3 ppm).

Keywords: Gill histology, Growth, Iron exposure, *Poecilia reticulata*, Red blood cell count

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Antibacterial effect of *Neolitsea cassia* extract on *Salmonella* and *Escherichia coli*

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Abstract

Foodborne diseases are mainly associated with the consumption of meat and meat products contaminated with pathogenic microorganisms such as bacteria, viruses and parasites. Among them bacteria play a vital role. *Salmonella* and *Escherichia coli* are considered as leading causes of food-associated bacterial illness globally. Antimicrobials are the drugs of choice to treat bacterial infections in human & animal and they are also used in sub-therapeutic levels to maintain animal and human health. Indiscriminate use of antimicrobials has resulted in the emergence of antibiotic resistant and the resistant bacteria can be transmitted to human through the food chain. In order to address this globally important issue, scientists are in search of alternatives to antibiotics, hence the researches on natural products are increasing. The present study investigated the *In vitro* antibacterial effect of *Neolitsea cassia* (*Dawul kurundu*) extract on *Salmonella* and *E. coli* isolated from broiler chicken meat. *In vitro* antibacterial effect against 11 *Salmonella* spp. and 04 *E. coli* isolates was studied by well diffusion assay with ethanol extract of *N. cassia* at three different concentrations (500 mg/mL, 250 mg/mL and 125 mg/mL) and Ceftriaxone (30 µg) was used as the standard antibiotic. This study revealed that all the bacterial isolates showed growth inhibition at varying degrees with three different concentrations of the ethanol extract where the significantly ($p<0.05$) highest inhibition was found at the 500 mg/mL concentration of the extract for all the tested isolates. Maximum inhibition among *E. coli* isolates was 19.81±2.64 mm whereas among *Salmonella i*solates was 18.99 ± 0.32 mm at 500 mg/mL of ethanol extract of *N. cassia*. The lowest inhibitions by the *Salmonella* and *E. coli* isolates were 8.05±1.14 mm, 8.13±1.27at 125 mg/mL, respectively. This study revealed that even though the standard antibiotic exhibited the highest inhibition against the selected bacterial isolates (33.38±2.47 mm for *Salmonella* and 24.58±2.49 mm for *E. coli*), *N. cassia* extract also showed an antibacterial effect signifying the possibility of using it to control Salmonella and *E. coli*.

Keywords*: Antibacterial, Antibiotic resistant, E. coli, Neolitsea cassia, Salmonella*

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Influence of nutritional level on mono- and dual-species biofilm formation by *Escherichia coli, Salmonella* and *Proteus*

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Abstract

Biofilms are microbial community adhered to biotic or abiotic surfaces and embedded within an extracellular Polymeric matrix. They have potential to resist antibiotics and disinfectants, causing health concerns in medical and food industries. Biofilm formation is affected by nutrient availability, temperature and other environmental factors. The present study was conducted to study the mono- and dual-species biofilm formation of bacteria, using *Escherichia coli, Salmonella* and *Proteus*, and their combinations, in two different nutritional levels of the growth medium (undiluted Luria-Bertani Broth - LBB and 1:100 diluted LBB). Biofilm forming ability was assessed by crystal violet microtiter plate assays, incubated at 28 ºC. The optical density was measured at 600nm wavelength. Undiluted LBB was more inductive in biofilm formation compared to 1:100 diluted LBB. *E. coli* formed a stronger biofilm (1.31 ± 0.32) in undiluted LBB than in diluted LBB (0.41 ± 0.15). Similar patterns were observed for *Salmonella*, *Proteus* and their combinations tested. *Proteus* also exhibited greater biofilm formation (2.0894±0.32) at undiluted media and lower in diluted media (1.1174±0.37). *Salmonella* showed optical density of 1.8602±0.24 at undiluted media and 1.0312±0.33 at diluted media. Combinations of *Salmonella-Proteus*, *Salmonella-E. coli* and *Proteus-E. coli* also demonstrated greater biofilm formation in undiluted LBB (2.08 ± 0.35, 0.92 ± 0.32 and 1.67 ± 0.41) compared to that in diluted LBB (1.25 ± 0.41, 0.72 ± 0.15 and 1.12 ± 0.34). Results also revealed that the biofilm formation by dual species was greater than that of mono-species. The combination of *Salmonella* with *Proteus* showed significantly higher biofilm formation than the combination of *Salmonella* with *E. coli*, and *E. coli* with *Proteus*, in both the diluted and undiluted LBB. The study indicated the effect of nutritional levels on biofilm formation of *E. coli*, *Salmonella Proteus* and their combinations, with greater biofilm formation at higher nutritional levels.

Keywords: Biofilm, Mono-dual-species, Nutritional level

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Assessment of efficacy of electrical water bath stunning on meat quality and welfare of broiler chickens

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Abstract

Stunning prior to slaughtering is practiced to minimize pain and suffereing of farm animals. The aim of the study was to assess two electrical parameters to obtain an efficient water bath stunning in broiler chickens. In this study two different electrical parameters (high intensity and high voltage current: 400 mA-600 mA and 40 V, low intensity and low voltage current 200 mA-400 mA and 20 V-25 V) with a constant frequency (280 Hz-300 Hz) were assessed to detect the efficacy of water bath stunning and meat quality of broiler chickens (Live body wt: 2.0±0.2 kg, 35±2 days old). Initially pre slaughter stress was detected using a panting scoring system and assessing wing flapping frequency. Efficacy of stunning of the birds was assesses observing behaviors and reflexes just after applying the electric current at the water bath and just before the neck cutting of the birds. After the neck cutting, reflexes and behaviors were assessed to find out time at brain death. Carcass quality was assessed based on the degree of external damage (blood spots, hemorrhages, broken bones). Statistical analysis was done by using SAS 9.4 softwear. There was no difference ($P>0.05$) in pre-stunning stress between the two treatment groups. None of the bird exhibited eye blinking, head shaking, look around and neck muscle tone just after stunning and just before neck cutting for the high electrical parameters. However, nearly 4% of birds showed these reflexes and behaviours for the low electrical parameters indicating lower stunning efficacy. Mean time to loss of reflexes and behaviours after neck cut indicated faster death in stunned birds than in the conscious birds. Carcass quality assessment revealed that higher number of birds stunned with high electric parameters had blood spots in wings and hemorrhages in the breast ($P<0.05$). The electrical parameters did not affect on color values and water holding capacity of the carcasses. In overall, results revealed that the high electrical parameters were more efficient in water bath stunning to achieve humane slaughtering. However, the high electric parameters comparatively reduced the meat quality of broiler chickens.

Keywords: Carcass quality, Electrical water bath stunning, Reflexes, Meat quality, Pre-stunning stress

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Poster Presentations

Management practices adopted by dairy farmers during milking and transportation in the Jaffna district, Sri Lanka

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Abstract

This study focused on investigating the milking management practices adopted by dairy farmers in four major milk collecting organizations of the Jaffna district in Sri Lanka. The study was carried out from February 2020 to July 2020. Out of 2254 farmers supplying milk to four major milk collecting organizations, 15% of the farmers were randomly selected for the current study. Information from the selected farmers was gathered using a structured questionnaire. Data were analysed using Proc frequency and Chi-Square test in SAS. The overall results revealed that the predominant method of milking method was hand milking (99%) with twice a day milking frequency (59.9%). Eighty-three percent of dairy farmers used metal containers to transport milk. 58.4% of the farmers relied on dug well as a source of water for dairying activities. 12.4% of dairy farmers faced water shortage problem for dairying. Ninety-three percent of the farmers cleaned the milk yard before milking. Mainstream of dairy farmers (79%) filtered milk before delivering to the collection points, where they mostly used metal containers (83%) and plastic filters (83%). Most of dairy farmers (99-100%) washed their hands, utensils, and udder before milking. 72% of milk producers practiced drying udder after wash; out of them majority (94.6%) used cloths as drying material. The majority of the farmers allowed the calf to suck the milk before milking (92%), monitored animal health before milking (95%), and delivered the milk to the collection point within one hour of milk collection (99%). The differences among collection organizations were significant for type of containers, shortage of water, schedule of cleaning the yard, frequency of milking, filtering the milk, filter material, allowing calves to suckle before milking and cow health monitoring. The differences among collection organizations were not significant for the method of milking, source of water, washing of hands and pails before milking, washing the udder before milking, drying of udder after wash, udder drying material, and transport time to collection centres. The study revealed that there is room for improvement in the hygienic practices adopted by the farmers in the study area. Educating dairy farmers regarding the appropriate hygienic management practices will enhance clean milk production.

Keywords: Jaffna district, Management practices, Milk collecting organizations, Raw milk

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Evaluation of public perception on Black Soldier Fly (*Hermetia illucens*) Larvae (BSFL) production domestically as a substitute for fish meal in Ratnapura district

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Abstract

Marine overexploitation to produce quality fish meal to meet the increasing livestock feed demand is threaten to the natural resource sustainability. Black soldier fly larvae (BSFL; *Hermetia illucens*) as non-pest, is positively proven for its exceptional bio-waste degradation ability into crude proteins and fats and spinning-off organic fertilizer. It can be used as a protein replacement for expensive fish meal. Locally it is hardly evidenced and present in media on this concept. The current study aimed to evaluate the public perception on producing BSFL based protein production by own generated bio-degradable waste using a BSFL based compost bin. Further the research outcomes are looking forward for linking to protein production for local livestock sector while addressing the overwhelming urban waste management consequence. Random sampling technique was adopted to select 296 households and administrated a structured questionnaire in Ratnapura district. Descriptive statistics and Pearson correlation coefficient techniques were used to evaluate results. Average 0.956 kg of daily bio-degradable waste was generated and 66.9% were practiced to collect their waste into a bin. 84.1% of them were using public waste collection service and 90.5% of the amongst were practiced to separate waste as per the local authority request. Among the respondents, 8.4% were aware on BSFL based protein production mainly through newspapers (64%) and there were positive responses (51.2%) for adapting to BSFL production and composting processes. People who disliked producing BSFL, mainly, less experiences on this regard (47.22%). 64.2% and 61.85% people were willing to use and purchase BSFL based compost bin, respectively. People, who rejected to utilize BSFL based compost bin, stated mainly due to the less experiences and knowledge on this regard. 33.8% were aware on BSFL based composting technology mostly through newspapers (62%). Even though majorities were not aware on BSFL composting, 74.7% were willing to initiate BSFL based compost production. Noteworthy, space unavailability was one of the main reasons for their rejection of compost production. Negative but poor correlation indicated in-between socio-economic status and adaptation to BSFL production technologies. Less popularity of BSFL was highlighted and further public awareness is needed prior to commercialize of this concept.

Keywords: Bio-Degradable, BSFL, Fish Meal, Perception, Waste

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Perception and awareness of animal welfare related to meat consumption amongst the students in the Faculty of Agricultural Sciences of Sabaragamuwa University of Sri Lanka

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Abstract

Animal welfare is an emerging area in whole over the world, and it is not well established in the current education system in Sri Lanka. Thus, we assume that most people do not have a clear picture about the welfare of meat producing animals and humane slaughtering. This study was carried out to assess the awareness and perception of animal welfare related to meat consumption among the students of the Faculty of Agricultural Sciences of Sabaragamuwa University of Sri Lanka in order to get an idea on arranging future awareness programs on food animal welfare. This questionnaire included two major areas; meat consumption and the awareness of animal welfare. Surveyed data were descriptively analyzed by using IBM SPSS statistics. Respondents were randomly selected among the students and the data were gathered by using Google forms online. This study group comprised of 42 males (21%) and 158 females (79%). Among the respondents, 88% consumed meat. Most of the respondents' awared of different killing methods caused different level of pain and stress (83.0%) in animals, and 82.0% interested in animal welfare. Also, there was a relationship between the awareness about the different killing methods caused different level of pain and stress and the type of meat (stunned or not stunned at the time of killing animals) most prefer to eat (α=0.05, p= 0.020). Also, there was a relationship between the engaged degree program and the interest for the animal welfare (α=0.05, p= 0.006), and meat consumption with gender (α=0.05, p=0.031). Majority of the respondents had a positive perception on food animal welfare. Thus, it is concluded that there is a good potential to arrange awareness programs on importance of animal welfare in meat production among the surveyed population.

Keywords*:* Animal welfare, Animal welfare-friendly product, Meat consumption, Pain

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Pre-slaughter stress conditions, efficacy of electrical water bath stunning, and meat quality of broiler chickens reared in opened houses and closed houses

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Abstract

Avoiding pain or suffering during the process of slaughter is important to ensure the welfare of animals. This study was conducted to identify the effects of two different housing systems on pre-slaughter stress, efficacy of electrical water bath stunning (electrical parameters: voltage=20-30 V, current=200-400 mA, frequency=300 Hz), and meat quality of stunned broiler chickens. A total number of 104 birds (49 closed housed birds, 55 opened housed birds) were assessed (Body weight: 1.9±0.1 kg, 35±2 days old) in the study. Statistical analysis was done by using SAS version 9.0 and Minitab 19 software. Panting was assessed according to the severity of panting by using a scoring scale from 0-2. Closed housed birds showed severe panting ($P<0.05$) at the lairage in comparison to opened housed birds. Observed reflexes and behaviours to detect the efficacy of water bath stunning were not different between the two groups except jaw tone which was exhibited by 96% (25/26) of opened house birds and 47% (10/21) of closed house birds ($P<0.05$). Shorter time to loss of jaw tone and pupillary light reflex were observed in the opened house birds (14±1 s and 16±1 s, respectively) than in the closed house birds (29±1 s and 24±1 s, respectively) indicating shorter time to brain death in opened house birds after neck cutting. Neck muscle tone, beak movement and head shaking were started earlier in the opened house birds than in the closed house birds ($P<0.05$) indicating faster recovery. Ultimate pH and water holding capacity were significantly higher in opened housed birds ($P<0.05$). There was no difference ($P>0.05$) in meat color values between the two groups. This study revealed that closed housed birds were more stressed prior to slaughter and resulted in lower quality meat with hemorrhages in the carcass. There was no effect of the housing system on the efficacy of water bath stunning.

Keywords: Broiler chickens, Electrical water bath stunning, Housing systems, Meat quality, Pre-slaughter stress

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Detection of mycoplasma from Goat lungs collected from Abattoir samples

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Abstract

Respiratory diseases are a major cause of death in goat kids and decreased productivity in older goats. Several *Mycoplasma* species cause respiratory diseases in goats. Respiratory *Mycoplasma* infections have not been reported in Sri Lankan goats. However, previous studies have reported relatively high prevalence of respiratory *Mycoplasma* infection among goats in neighboring countries. The highest incidence was reported in Pakistan (20%) followed by India and Bangladesh (8%). PCR is a rapid and simple method of detection and identification of the *Mycoplasma* species. The present study investigated the occurrence of *Mycoplasma* in goats using randomly selected lung samples obtained from Colombo municipal slaughterhouse using PCR. A total of 36 lung samples obtained from the slaughterhouse along with one sample from a goat that died of atypical pneumonia were used in this study. The DNA was extracted using DNeasy blood and tissue DNA extraction kit (Qiagen) according to manufacturer's instructions and PCR was performed using genus-specific primers for *Mycoplasma* and species-specific primers for *Mycoplasma arginini, Mycoplasma ovipneumoniae* and *Mycoplasma mycoides* subspecies *capri* according to previously described protocols. It was observed that 63.8% (23/36) of the samples were positive for *Mycoplasma* genus. The clinical case was also positive for *Mycoplasma* genus. This study has provided preliminary evidence for the presence of *Mycoplasma* from respiratory tract of goats in Sri Lanka. Further studies are necessary to identify specific pathogenic *Mycoplasma* spp. causing respiratory infections in Sri Lankan goats.

Keywords: Abattoir samples, Incidence, *Mycoplasma*, PCR, Primers

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Effect of transport distance on pre-slaughter stress, efficacy of water bath stunning and meat quality in broiler chickens

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Abstract

Effective stunning of broiler chickens before slaughtering reduces the pain and suffering and improves welfare significantly. The objectives of this study were to assess the effect of transport distance on pre-slaughter stress, efficacy of water bath stunning carcass quality and meat quality of broiler chickens. This study was conducted at a commercial meat processing plant using 123 broiler chickens (Body wt:1.8±0.2 kg, 35±2 days old) reared in closed house farms which were located in three different distances to the processing plant (10 km: N=47, 75 km: N=41 and 130km: N=35). Electrical parameters used were: voltage = 20-30V, current = 200-400 mA, frequency = 300 Hz. Statistical analysis was done using SAS university edition software. Severity of panting was higher in the birds transported from 75 km distance while severity of wing flapping at shackling was significantly ($p<0.05$) higher in the birds from 10km distance. Number of birds observed for reflexes and behaviors to detect the efficacy of stunning did not differ among the groups except beak movements which was the lowest ($P<0.05$) in the birds from 75 km distance. The birds transported from 75 km exhibited longer time to loss many reflexes and behaviors after neck cut indicating longer time to death than the other two groups. Higher number of birds from 130 km distance had breast blood spots, wing hemorrhages, broken bones and higher degree of wing tip damages indicating carcass defects were relatively higher in the birds from 130 km than the birds from other two distances. There was no significant difference ($P>0.05$) in ultimate pH and meat color (L*, a* and b* values) among the groups. However, water holding capacity (WHC) of meat was different ($P<0.0001$) among the groups where birds from 10km had the highest WHC (60.75±0.61%) followed by 130 km (57.58±0.73%) and 75 km (54.52±0.1%). Results concluded that there was no effect of transport distance for the efficacy of water bath stunning and the birds transported from 130 km had lower level of carcass quality. Possibility of higher level of pre-slaughter stress was observed in the birds transported from 75 km distance.

Keywords: Broiler chickens, Meat quality, Pre-slaughter stress, Transport distance, Water bath stunning

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Effect of a grass mixture on the production performance of mid lactation dairy cows

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Abstract
In the present study, the changes in the feed intake, milk yield and composition of mid lactation dairy cows under two nutritional regimes [roadside grasses (R) vs. roadside grasses + sugar graze (RS)] were evaluated in order to test the production performance under local conditions. The experiment was a two-period, cross over design with four cross bred lactating cows allocated to each feeding regimen. Each period consisted of 21 days of adaptation followed by 7 days data collection. During the experimental period, two dietary treatments were individually offered and *ad libitum* intake was ensured throughout. Dry matter, crude protein and crude fiber contents of the diets offered had significant differences, while these differences had an effect on dry matter intake, milk yield as well as the quality of milk. The RS diet had more protein than R diet. Thus, combination of Sugar graze could have been enhanced the crude protein content in road side grass mixture. Additionally, high Organic matter digestibility and Metabolizable energy in RS diet could have ensured better synchronized energy and protein for ruminal digestion. RS diet fed cows produce 57.28% more milk ($p<0.05$) than the R diet fed cows is a reflection of the quality of the diet. In present study, compared to cows fed R diet, higher fat (4.09%) and proteins were recorded in milk of cows fed RS diet. This may be attributed to higher non-fiber carbohydrates, less fiber associated with better digestibility of nutrients in the RS diet. Therefore, the current findings demonstrated that feeding good quality forage can easily increase the milk production of mid lactation dairy cows by more than 50%. Most economical way to do this could be replacing some portion of low quality roughages in the diet by a nutritionally superior variety, such as fodder sorghum.

Keywords: Energy, Mid lactation, Road side grasses, Sugar graze

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Public perception and awareness of livestock welfare: A survey among the village community in Balangoda Sri Lanka

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Abstract

Animal welfare is an emerging phenomenon, and relatively a new field to the livestock sector in Sri Lanka. The current study aims to provide a better insight into perception and awareness of livestock welfare among village community and to identify the potential, and facts that need to be considered when implementing public awareness programme. The questionnaire included five major areas such as 1. Awareness of farm animal welfare, 2. Awareness of living condition of farm animals, 3. Awareness of humane practices in livestock management, 4. Buyer's willingness to pay for livestock welfare, and 5. The requirement of awareness programme and legislations of livestock welfare. Data were descriptively analyzed by using SAS 9.4 version. Villagers were randomly selected and interviewed face to face. From 150 questionnaires, 78 of the respondents had no idea of the term animal welfare. Among the respondents, majority believed that the most important aspects of animal welfare are exhibiting natural behaviour (26%) and exposing to the natural environment (36%). Moreover, 70% of respondents believed that living condition is important to livestock. All the respondents believed that transportation is a stress factor. Overall, 90% of respondents stated that killing is painful, and they also believed that stun prior to killing is a better practice than killing conscious animals. However, 30% of respondents did not concern about livestock welfare-friendly products, and 26% did not like to pay more for those products. Everyone agreed that school children and small-scale livestock farmers should be educated about animal welfare. Few (8%) believed that education of the public on livestock welfare is difficult. Every respondent stated that the introduction of new laws needs to ensure livestock welfare and they stated that they are not aware of the current existing laws of animal welfare. In conclusion, majority of the respondents had positive attitudes on improving livestock welfare indicating that there is a good potential to implement public awareness programs on livestock welfare among the village community in the district.

Keywords: Farm animals, Humane killing, Laws in animal welfare, Public awareness

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Food and Nutrition

Keynote Speech

Physiology and enzymology in acetic acid bacteria

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Abstract
Acetic acid bacteria (AAB) are a group of aerobic bacteria, including a vinegar producer. In the twentieth century, basic research on the taxonomic study of AAB and on biochemical study for the unique oxidative reactions of AAB progressed as did during the industrial applications of AAB not only in vinegar fermentation but also in the bioconversion process for useful chemical or pharmaceutical products. Entering the twenty-first century, AAB research has continued to expand and is expected to show further progress in all aspects of AAB: classification and ecology, physiology and biochemistry, genetics, and biotechnology of vinegar fermentation and other oxidative fermentations. The research on AAB has developed significantly in the last decade, which makes these bacteria more valuable for various industrial applications.

This keynote initially describes the introduction of AAB. Then, traditional vinegar fermentation in Japan is explained. Then strategy for resistance against acetic acid in AAB is explained. Enzymes involved in vinegar production are explained in detail, especially about membrane-bound alcohol dehydrogenase (ADH). ADH contains pyrroloquinoline quinone (PQQ) as a prosthetic group. PQQ is a redox active compound and shows some physiological activity for not only bacteria but also plants and mammals. Finally, oxidative fermentation and thermo tolerance AAB will be discussed.

Keywords: Acetic acid bacteria, Oxidative fermentation, Pyrroloquinoline quinone, Vinegar

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Oral Presentations

Relationship between phytochemical changes and colour development in Tomato *(Solanum lycopersicum* L.*)* fruit during ripening

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Abstract

Tomato *(Solanum lycopersicum* L.*)* is major dietary source of antioxidant such as lycopene, total carotene and ascorbic acid. Lycopene is a bright red carotenoid pigment and most potent antioxidant among dietary carotenoids. This study was to (a) investigate the change of phytochemical content in tomato fruit during ripening, and (b) find the relationship of colour changes and lycopene content in tomato fruit. Physicochemical properties investigation carried out on, pH, total soluble solid (TSS), ascorbic acid, lycopene and total carotene content, Total Phenolic (TPC) and Total Flavonoid content (TFC). Fruit colour which is important physical characteristic to assess ripening of tomato fruit were assess using chroma meter as L*a*b* values. The a* value was considerably increase with fruit colour development of tomato. The significantly highest pH was recorded in dark red stage (4.96 ± 0.0829) and followed by the lowest pH was recorded in green stage (3.81 ± 0.0505). The significantly highest TSS was recorded in dark red stage (5 ± 0.1333%) and the lowest pH was recorded in green stage (3.9 ± 0.4243%). The significantly highest lycopene content revealed in dark red stage (205.469 ± 10.84mg/kg) and followed by the lowest resulted in green stage (6.379 ± 0.4268 mg/kg). The highest total carotene content resulted in dark red stage (0.4165 ± 0.0278 mg/kg) and the lowest resulted in green stage (0.0291 ± 0.00225 mg/kg). The highest ascorbic acid revealed in dark red stage (14.432 ± 1.797%) and the lowest revealed in green stage (0.76763 ± 0.4320%). The Folin Ciocalteau method was resulted significantly highest TPC in dark red stage (0.5569±0.041mg Gallic acid equivalent/g) while lowest resulted in green stage (0.0969 ± 0.051 GAE/g). The significantly highest TFC was resulted in dark red stage (0.5569±0.0020 Quercetin equivalent/g) while lowest resulted in green stage (0.0969 ± 0.0067 Quercetin equivalent/g) of fruit. There was a better fit linear correlation between lycopene and (a*/b*) value and same as total carotene and (a*/b*) value. (R^2=0.8572 and R^2=0.7337 respectively). The result shows the phytochemical content of tomato fruit increase with fruit color development. The a* value is the best physical parameter to measure the colour of the tomato fruit to detect the colour development during ripening. There is a positive correlation between colour development and lycopene content of tomato fruit and also with the total carotene.

Keywords: Antioxidant, Carotene, Lycopene, TFC, Tomato, TPC

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Stability of bioactive compounds available in *Bapoca monnieri* under different processing techniques

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Abstract

The plant, *Bacopa monnieri (L.) Pennell* has traditionally utilized as herbal remedies to cure various ailments under different processing techniques, even though the availability of bioactive compounds has not been explored scientifically. The present investigation mainly focused on comparing the stability of phytochemicals under selected treatments domestically practiced in Sri Lanka, using the whole plant employing standard procedures and qualitatively and quantitatively investigating selected phytochemicals. The 4 different processing techniques (Treatment) were followed. Treatment 1 (salad) was prepared without mixing extra ingredients or heat treatment for the washed and chopped plant material. Treatment 2 (mallum) was prepared by giving moderate heat of 80 ^{o}C (5mins). Treatment 3 (fried) was prepared by giving 105 ^{o}C (5mins). Treatment 4 (concentrate) was prepared by concentrating water extract 8 into 1 volume at higher temperatures (>150 ^{o}C). The presence of selected phytochemicals, particularly the alkaloids, flavonoids, tannins, phlobatannins, total glycosides, steroids, saponins, quinones, leucoanthocyanidines and phenolic compounds were qualitatively determined. Alkaloid, flavonoid, saponin, tannin, total phenolic compounds and antioxidants were quantitatively analyzed. According to the results of qualitative analysis alkaloids, flavonoids, tannins, phlobatannins, quinones, leucoanthocyanidines and phenolic compounds were positive but steroids, glycosides and quinones were not positive under treatment 4. The other compounds were available in treatment 1, 2 and 3 samples. The highest total phenol content (27.82$\pm$10.08 mg/g), saponin (4.92$\pm$0.99), alkaloid (6.47 $\pm$ 1.65) and tannin (0.11 $\pm$ 0.01 mg/g) content were reported in the sample that carried out treatment 4. The highest contents of antioxidants (43.97$\pm$0.45 mg/g) and flavonoid (3.40$\pm$0.31 mg/g) were reported upon treatment 1. According to GC-MS analysis, a total of 26, 24, 15 and 18 molecules were identified orderly in treatment 1, 2, 3 and 4. The medium used was chloroform: methanolic (4:1) extract. Variation of the amounts of these compounds has happened due to the cooking treatments. Therefore, these changes were the reason for the traditionally practiced plant's utilization methods as the above treatments for different ailments.

Keywords: Anti-oxidants, Alkaloids, Flavonoids, GC-MS, Tannins

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Study on physicochemical properties of selected edible oils available in Sri Lankan local market

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Abstract

Olive (OO), sunflower (SO) and palm oil (PO) are three different types of highly demanded oils available in Sri Lankan local market with multivariate functions. The present study aimed to evaluate the quality parameters of randomly picked oil samples in Sri Lankan local market at the time of purchasing. Ten brands (Three brands of OO, three brands of SO and four brands of PO) of oil samples were purchased from local market. Specific gravity, viscosity, color, free fatty acid (FFA) and peroxide value (PV) of all the oil samples were measured. PV and FFA of OOs were ranged from 7.47 ± 0.95 meq/kg to 4.47 ± 0.23 meq/kg and 0.52 ± 0.11% to 0.38 ± 0.05%, respectively. Thus, the recorded PV values are complying with the SLS standards and FFA values are not in some brands (1591:2018) (maximum FFA as oleic acid: 0.3% and maximum PV: 10 meq/kg). Specific gravity and color of three brands of OO were significantly different ($P<0.05$) while viscosity was not ($P>0.05$). PV and FFA values of SO were ranged from 14.80 ± 3.02 meq/kg to 7.67±0.70 meq/kg and 0.86 ± 0.30% to 0.53 ± 0.11%% respectively. The recorded PV values of some brands in SO are comply with the SLS standards (946:2018) (maximum FFA as oleic acid: 0.25% and maximum PV: 10 meq/kg) and PV values of other brands and all FFA values are not. Specific gravity, viscosity and color of three brands of SO were significantly different ($P<0.05$). PV and FFA of PO were ranged from 0.36 ± 0.12 meq/kg to 0.25 ± 0.02 meq/kg and 11.13 ± 1.43% to 7.07 ± 0.69% respectively. Thus, the recorded PV and FFA of some brands are comply with the SLS standards (720:2016) (maximum FFA as palmitic acid 0.25% and maximum PV: 10 meq/kg). Within the three brands color and specific gravity of PO significantly different ($P<0.05$) and viscosity was not ($P>0.05$). In conclusion, physicochemical parameters of some brands in three different oil types are comply with the SLS standards and also show significant differences within the brands.

Keywords: Edible oil, Free fatty acid, Peroxide value, Physicochemical property

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Production of natural microbial colouring pigments by *Monascus perpures* in Sri Lankan rice varieties

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Abstract

Colouring agents are essential food additives used in the food industry and natural colouring agents have a high commercial value. Production of natural colouring agents from microorganisms is advantageous because they are natural, rapid production compared to plant extractions and has no seasonal limitations. *Monascus purpures* is a fungus that produces six major pigments, including red pigment suitable for food and it also has some health benefits such as reducing blood cholesterol and triglyceride levels. Therefore, this study aimed to assess the pigment production by *Monascus perpures* in Sri Lankan rice (*Oryza sativa*) varieties. Solid substrate fermentation was performed with 10 different samba rice varieties. The fungus was grown on PDA and agar blocks containing fungal mycelia were used as the inoculums. The fermentation medium prepared with 25 g of rice samples were inoculated and incubated for 14 days at room temperature. The dried, powdered fermented rice samples were subjected to ethanol extraction, and the concentration of pigments was determined using different wavelengths in the Spectrophotometer. The rice varieties were also tested with supplementation of the fermentation medium with both organic and inorganic nitrogen sources. Out of the ten rice varieties, the red samba variety LD 368 had the highest pigment production and the absorbance was 34.48 at the red shift, 33.95 at the orange shift and 73.20 at the yellow shift. The results also revealed that when compared the three different pigment production in each rice variety, the concentrations of the red and orange colour pigments were very much similar, but the concentration of the yellow colour pigment was varied. Similar results were observed with all ten tested rice varieties. The results also indicated no difference in the pigment production in the presence or absence of the nitrogen sources in the fermentation medium.

Keywords: *Monascus perpures*, Pigment Production, Solid State Fermentation, Sri Lankan Rice

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Sustainable utilization of crude rice bran wax for the development of lipid-based *e*dible coatings

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Abstract

Rice bran wax is a byproduct of rice bran oil refining process in Sri Lanka, which is also used as a feed of cattle and as a raw material for candle production although it has many nutrients for known health benefits. Present study used two treatments for purification of crude rice bran wax. First treatment was a two steps process. The First step of it was the removal of residual oil from crude wax with hexane. After that it was subjected to further defatting with Isopropyl Alcohol which yielded a light-yellow color powder. AOAC method 965.33, AOAC method 920.157 and SLS 313 methods were adopted for the analysis of peroxide value, melting point, Free Fatty Acid (FFA) and acid values respectively. The results are as follows; melting point of the sample is 78 ^{0}C, moisture content 1.25 ± 0.00 %, FFA content 4.9981 ± 0.00 %, acid value 7.8702 ± 0.00 ml NaOH/g and peroxide value 17.036 ± 0.00 mEq/Kg. The second step of the treatment followed by bleaching with 10% sodium borohydride in IPA which yielded a light-yellow dry powder with melting point of 80 ^{0}C, moisture 1.02 ± 0.00%, FFA 0.7664 ± 0.00 %, acid value 1.0852 ± 0.00mL NaOH/g, peroxide value 13.6034 ± 0.00 mEq/Kg. The Second treatment was a single step process where crude rice bran wax refluxed with 99% ethanol which yielded a light-yellow color powder with a melting point of 79 ^{0}C, moisture 1.56 ± 0.00%, FFA 0.8123 ± 0.00 %, acid value 1.1502 ± 0.00 mL NaOH/g, peroxide value 13.65 ± 0.00 mEq/Kg. Fourier Transform Infrared Spectroscopy analysis of refined rice bran waxes from both treatment procedures indicated that those samples contained following functional groups such as; aliphatic primary amine, esters, α and β unsaturated esters, alcohol group, alkane group and aldehyde group. There is no any significant difference between the two refined samples obtained from the two treatments with regards to peroxide value, FFA, melting point and acid value, except moisture. Finally, it can be concluded that the second method is comparatively cost effective and easy method to refine the rice bran wax for further utilizing processes such as developing edible fruit and vegetable coating waxes.

Keywords: Crude rice bran wax, Purification, Refined rice bran wax, Rice bran oil

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Biofilm formation of mono and dual Bacterial Species (*Escherichia coli* and *Salmonella*) on different food contact surfaces

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Abstract

Biofilms are microbial associations as communities on a biotic or abiotic surface by secretion of matrix where they thrive in stressful environments. These communities can be formed by single species or by multiple species that is differing from their planktonic state and are capable of surviving on food contact surfaces. This process creates huge problems in food industry by causing higher contamination, antibiotic resistance and food spoilage. In addition, these biofilms have higher resistance to disinfectants and sanitizers too. The present study was carried out to evaluate the biofilm formation ability of mono-species (*E. coli* and *Salmonella spp.*) and multispecies (*E.coli*+*Salmonella spp.*) on different contact surfaces (Stainless steel, glass and tile) which are used in food processing plants. *E. coli* and *Salmonella spp.* used for the study were isolated in a previous study from broiler chicken meat. Biofilm formation by *E coli, Salmonella spp.* and *E coli* + *Salmonella spp.* on glass, tile and stainless steel surfaces were measured at ambient temperature in Luria Bertani Broth medium for 24, 48, 72, 96, 120, and 144 h of incubation time. The quantification of biofilm formation was performed by enumeration of viable biofilm cell count using the spread plate method. The results revealed that biofilm formation by *Salmonella spp*. was significantly high ($p<0.05$) on glass (8.0±0.21 Log CFU/cm^2). On stainless steel and tile surfaces the highest biofilm formation was by combination of both *Salmonella* and *E. coli* (i.e multiple spp.) (8.0±0.06 Log CFU/cm^2, 7.3±0.04 Log CFU/cm^2) respectively on stainless steel and tile. Biofilm formation by *E. coli* was significantly ($p<0.05$) high on stainless steel and low on tile (7.0±0.02 Log CFU/cm^2, 6.7±0.44 Log CFU/cm^2) and this is the least biofilm former. Biofilm formation by *Salmonella spp*. was significantly ($p<0.05$) low on tile (7.0±0.09 Log CFU/cm^2) whereas high in glass. Lower biofilm formation by dual species (*E coli* + *Salmonella spp*) was on tile (7.3±0.04 Log CFU/cm^2) compared to other two surfaces. The ability of biofilm formation by multi-species bacteria on stainless steel and tile surfaces studied was higher than the single spp. The study concluded that the biofilm formation ability is depend on surface and the type of bacteria. Also multi species bacteria have higher biofilm formation ability on some surfaces than the biofilm formation by single bacterial species.

Keywords: Antibiotic resistant, Biofilms, Food contact Surfaces, Mono-species, Multispecies

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Enrichment of iron into rice using natural raw materials

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Abstract

This study was progressed to identify the potential of producing iron enriched rice using natural raw materials with the aim of overcoming the high prevalence of iron deficiency in Sri Lanka. Initially four improved Sri Lankan rice varieties (*Oriza sativa* L.) (Bg-300, At-362, Bg-352, Bg-360) were analyzed for the proximate composition and water uptake capacities. The effect of parboiling and polishing steps in rice processing process on the proximate composition was also studied. The rice variety with the highest water uptake percentage was selected for the mineral enrichment treatments using leaves of *Moringa oleifera*. Finally, the iron content of the selected best treatment and untreated samples were compared. Among the selected rice varieties, percentage water uptake for paddy and de-husked whole grains were ranged from 45.95±1.29 to 143.37±5.84 and 32.14±0.92 to 168.94±5.22, respectively. At-362 recorded the highest percentage of water uptake for both forms. Paddy form and polished rice of At-362 were subjected for different treatment conditions with *Moringa oleifera* leaves. Among them treatment of paddy with minced *Moringa oleifera* leaves during hot soaking at parboiling resulted the maximum percentage ash content of 1.34±0.10. Control paddy sample showed only 1.21±0.03% ash content. Different paddy: leaves ratios were studied under this selected treatment condition and 10:9 paddies: leaves ratio which was resulted 1.96±0.11% of ash content was selected as the ideal ratio to develop iron enriched rice. Hence, the best method to enrich minerals into the rice grain using natural raw materials was identified as the treatment of paddy with minced leaves of *Moringa oleifera* during hot soaking (70 ˚C) at 9:10 ratio of leaves to paddy in paddy parboiling. According to the results of ICP-MS analysis, rice from paddy treated under these conditions was resulted in 18.72% increment in iron content and 38.10%, 41.16%, 95.97% and 114.38% increments in Mg, Mn, Ca and K, respectively. Hence it can be concluded that incorporation of *Moringa oleifera* leaves into the paddy parboiling mixture is a cost effective, convenient method to enrich essential minerals into rice and it is an effective method to address the iron deficiency problem meanwhile adding value into the rice.

Keywords: Iron, Minerals, Enrichment, Water uptake

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Quality analysis of commercially available selected bottled drinking water samples in Jaffna district

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Abstract

Bottle water is a great beverage choice for hydration and refreshment because it's consistent quality, safety, and convenience. Quality of safe drinking water refers to physicochemical and microbiological parameters that meet the WHO (World Health Organization) guidelines of national standards. Therefore, this study was aimed to evaluate the quality of selected bottled drinking water samples available in Jaffna District, Sri Lanka. Randomly selected ten different brands of bottled drinking water samples were collected from bottled drinking water selling shops. For the quality analysis, water samples from two batches were tested for physiochemical (pH, Electrical conductivity, Total Dissolved Solids, Total Suspended solids, Turbidity, Color, Odor, Taste, iron, Nitrate, Nitrite, Sodium, Potassium, Total Hardness, Magnesium, Calcium, Alkalinity, and Chloride) and Microbiological (Total bacterial Count) parameters. The results of the above samples were compared with the SLS (Sri Lankan Standards) recommended level to ensure the quality of the drinking water samples. All samples' pH values varied between the ranges of 6.9 - 9.61, whereas electrical conductivity values varied between 12.58 - 202.58 µS/cm and total alkalinity and turbidity values varied between the ranges of 93.33 - 203.33 mg/L and 0.215 - 0.321 NTU, respectively. Further, total dissolved solids, sodium, total suspended solids, potassium, iron, hardness, magnesium, chloride, and calcium content of all studied water samples were 2.491 – 99.678 mg/L, 0.5 – 17.25 ppm, 0 mg/L, 0.270 – 1.50 mg/L, and 0 - 0.681 mg/L, 5.01 – 10.73 mg/L, 1.1-2.06 mg/L, 37.86 – 62.71 mg/L, and 1.96 – 17.79 mg/L, respectively. Moreover, nitrite and nitrate values for water samples varied between 0 to 0.0038 mg/L and 0.683 to 2.983 mg/L, respectively. All studied water samples were colourless, tasteless, and odourless for organoleptic analysis. Total microbial count varied between 0 and 13 CFU. According to the results, it is obvious that bottled drinking water has good quality for the selected samples. Among all samples studied for the physicochemical parameters, obtained value for bottled drinking water showed less than SLS permitted level. However, in the case of microbial quality, some samples were showed colonies for both batches. Therefore, this study concluded that proper sanitation practices need to be followed in respective bottled water producing industries to ensure safe drinking water for all.

Keywords: Bottled water, Chemical parameters, Microbial count, Physical parameters, Water quality

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Poster Presentations

Comparison of iced tea types in Sri Lanka and Australia

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Abstract
Iced tea industry is a popular industry around the world. Australia is a country with high consumer demand for iced tea and a variety of iced tea categories. As a country that has cultivated tea in abundance, Sri Lanka has also been producing a lot of iced tea varieties for the last few years. Data available on the quality of the iced tea types are scarce. The quality of iced tea depends on its physicochemical parameters such as antioxidant activity (AA), total polyphenol content (TPC), titratable acidity (TA), total soluble solids (TSS) and turbidity. The aim of this study was to perform a research that compares the above-mentioned physiochemical parameters of the iced tea types available in Sri Lanka and Australia. Five different iced tea types (in aqueous extract) from both Sri Lankan and Australian origin were tested in the forms of green tea, black tea, peach flavoured tea, lemon flavoured tea and apple flavoured tea. The properties were measured by physicochemical tests. The DPPH assay was performed to determine the free radical scavenging ability and polyphenol content was determined through the Folin-Ciocalteu method. The Sri Lankan varieties showed AA in 5.1-22.2GAEμg/mL, TPC in 2.45-19.8GAEμg/mL, TA in 1.15-2.59g/L, TSS in 6.4-12.2°Bx and turbidity in 1.3-19.08NTU. The Australian product types reported AA in 3.9-5.1GAEμg/mL, TPC in 1.9-4.9GAEμg/mL, TA in 1.18-2.59g/L, TSS in 0.6-12.2°Bx and turbidity in 2.79-19.9NTU. The apple flavoured black tea of both countries depicted similar properties with AA in 3.9-5.1GAEμg/mL, TPC in 1.9-2.4GAEμg/mL, TA in 2.16-2.59g/L, and turbidity in 19.08-19.9NTU. The Sri Lankan green tea variety showed best overall characteristics with AA in 22.2GAEμg/mL, TPC in 19.8GAEμg/mL, 1.15g/L in TA, 6.8°Bx of brix value and 10.19NTU in turbidity. The Sri Lankan iced tea types showed the highest values in AA and TPC and lower values in TA for green tea, black tea and lemon flavoured tea. The TSS measures of both countries were quite similar and so was it for turbidity values except for green tea and black tea. According to the results it showed that the Sri Lankan iced tea varieties were higher in antioxidant activity and polyphenol levels. These results show that the Sri Lankan green tea variety has a higher quality with higher health benefits over the other iced tea types.

Keywords: Antioxidant activity, Iced tea, Iced tea quality, Tea, Tea quality

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Determination of nutritional composition of four banana varieties available in Sri Lanka

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Abstract

Banana (*Musa* spp.) is a widely grown and consumed semi perennial fruit crop in Sri Lanka. There are nearly thirty varieties of banana grown throughout the country either as dessert fruit or as cooking banana. However, the nutritional qualities of banana available in the retail market have not been explored enough. Therefore, the objective of the study was to evaluate the nutritional properties of widely consumed banana varieties in Sri Lanka. Four banana varieties having the highest availability and demand in the retail market i.e. *Ambul* (AAB), *Anamalu* (Cavendish type, AAA), *Seeni Kesel* (ABB) and Ash plantain (ABB) were evaluated for their nutritional qualities. For this, the samples were collected from three different market places in the upcountry intermediate zone and pooled. The proximate composition, flesh to peel ratio, vitamin C and potassium concentrations were determined and presented on fresh weight basis. The ranges for moisture, crude protein, crude fat and ash contents were 66.0±1.47 - 76.4±0.52%, 1.0±0.08 - 2.2±0.03%, 0.14±0.02- 0.61±0.04% and 0.98±0.07 - 2.29±0.04%, respectively. The vitamin C content varied between 3.13±0.27 mg/100 g in *Seeni kesel* and 8.35±0.33 mg/100 g in *Anamalu*. The highest potassium concentration (496.9±1.32 mg/100 g) and flesh to peel ratio (4.4±0.52) were recorded in *Seeni kesel.* Variety ash plantain possessed the highest crude protein and crude fat contents. Overall results revealed that the tested varieties of banana have unique and distinct nutritional properties and thus cannot be replaced by others to get the required benefits.

Keywords: Crude fat, Crude protein*, Musa*, Potassium, Vitamin C

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Application of Garlic (*Allium sativum*) extract as biodegradable edible coating to maintain the quality and to extend the shelf life of Tomatoes

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Abstract

Postharvest technology has been key to maintain and extend the shelf life of perishables and reduce food losses. Garlic has been used for a long time as a spice and traditional medicine. That contains allicin, which is one of the active principles of freshly crushed *garlic* act as a *antimicrobial* properties. The present research was carried out on the application of garlic extract on tomatoes, which act as an edible coating and disinfection activity with environmentally friendly technology. The freshly harvested, mature green tomatoes (var. 'KC-1') were dipped into 8, 12, and 16% (w/v) of garlic extract for 10 min, air-dried and stored at 15℃ and 30℃. The physico-chemical parameters such as pH, ascorbic acid content, total soluble solids (TSS as ºBrix) and shelf life of tomatoes were assessed once in 3 days intervals. It was observed that the tomatoes contained ascorbic acid, and total soluble solids were decreased, whereas their titratable acidity was increased during storage. There were significant ($p < 0.05$) differences were observed for ascorbic acid content during ripening of tomatoes, whereas the changes for pH and TSS were non-significant ($p > 0.05$). Sensory attributes including color, taste, texture, aroma and overall acceptability were evaluated by 20 semi-trained panelists by using a 7-point hedonic scale to assess the preference. Based on the quality assessment, tomatoes treated with 12% garlic extract was found to be the best concentrations, that was showed the highest retention of ascorbic acid, total soluble solids and pH, which were 7.67 mg%, 4.8 ºBrix and 3.7 respectively, following 21 days of storage at 15℃. Tomatoes treated with 16% garlic extract had the lowest scores for sensory quality due to decay and browning. From the results of Tukey's Studentized Range Test, the highest overall acceptability was found for the 12% garlic treated tomatoes at 15℃. The results of this study revealed that the tomatoes treated with 12% garlic extract and stored at 15℃ was found to be as the best treatment with the shelf life of 21 days owing to delayed ripening with highest overall acceptability.

Keywords: Garlic extract, Nutritional quality, Refrigerated storage, Sensory attributes

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Systematic benchmarking of novel Herbal Tea blend against Commercial Green Tea in sensory, physico-chemical and functional properties

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Abstract

Green tea is a trendy global beverage among people who pursues a healthy and long lifespan. A country like Sri Lanka having great herbal diversity could obtain much higher synergetic effect on healthiness over usual green tea by blending it with other medicinal herbs. This study was aimed on benchmarking a formulated novel herbal tea blend comprised of three herbs; *Garcinia quaesita* (Goraka), *Psidium guajava* (Pera), and *Cinnamomum verum* (Kurundu) which are known to associated with anti-hyperglycemic properties. The benchmarking of the novel tea product was done in all sensory, physico-chemical and functional aspects, against a well-established, commercial green tea brand in Sri Lanka. Brix, pH and colorimetric values were taken for both tested samples. Total phenolic content and total flavonoid content were determined using Folin-ciocalteu method and Aluminium chloride colorimetric method respectively, whereas antioxidant capacity was determined using ferric reducing/antioxidant power method. Sensory evaluation was carried out with 30 panelists for color, aroma, taste, after taste and overall acceptability using 5-point hedonic scale. The pH of the formulated novel tea (5.5) was much lower compared to the commercial green tea (6.9). Total polyphenolic content was, 1.945 mg/mL Gallic Acid Equivalent, total antioxidant activity was, 3.365 mg/mL Trolox equivalent and total flavonoid content was 36.3 ppm Quercetin Equivalent for formulated novel tea blend. While, commercial green tea showed, 1.867 GAE mg/mL, 2.77 TE mg/mL, and 26.92 QE ppm for above Parameters, respectively. In the sensory evaluation, a significant ($P<0.05$) preference was received by novel tea blend in all aspects except color, whereas brix and colorimetric values were compatible with commercial brand. In conclusion, newly formulated tea blend is more acceptable in organoleptic preference, physico-chemical compatibility and antioxidant properties which ultimately would be beneficial to improve hyperglycemia conditions.

Keywords: Benchmarking, Functional properties, Herbal tea blend, Sensory evaluation

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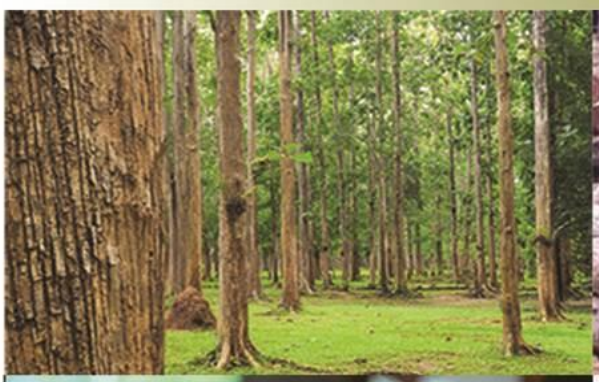


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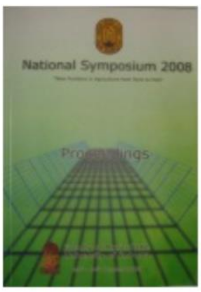

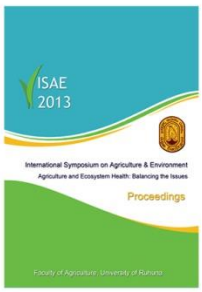

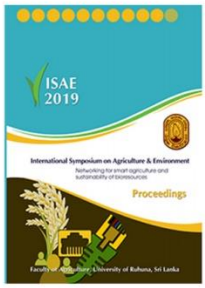

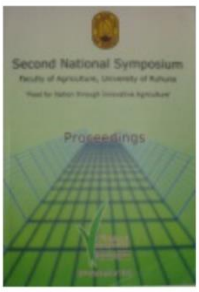

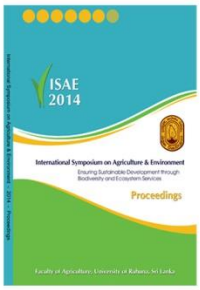

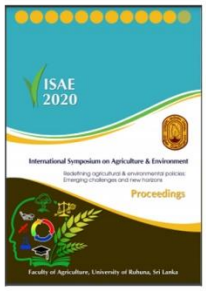

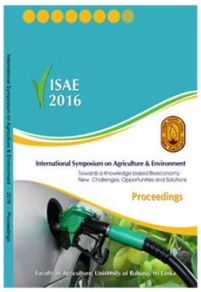

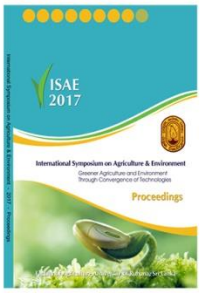

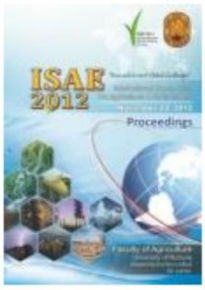

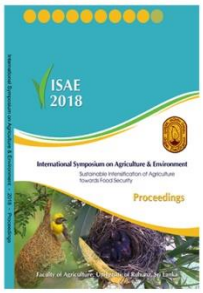

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